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VOL. XXXI.

PART 1

The JOURNAL Of The Department of AGRICULTURE VICTORIA AUSTRALIA



JANUARY

133

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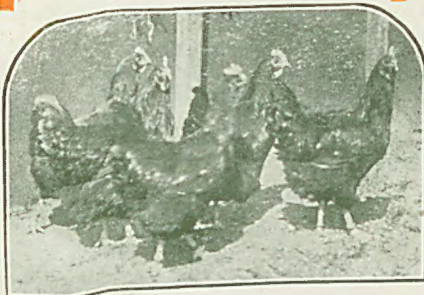
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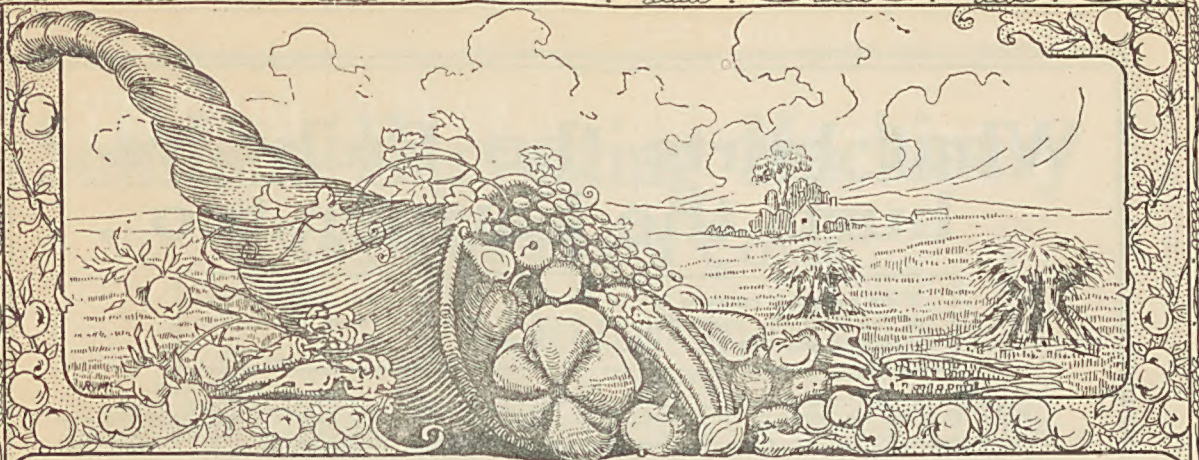
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Issued under the direction of the Hon. J. Allan, M.L.A., Minister of Agriculture.

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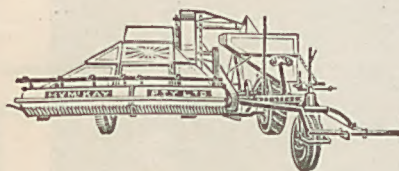
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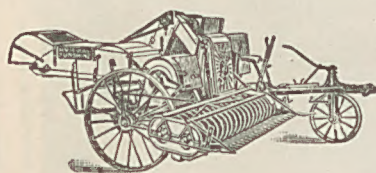


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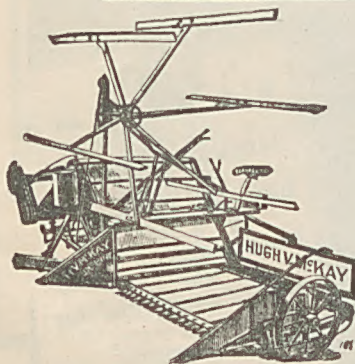


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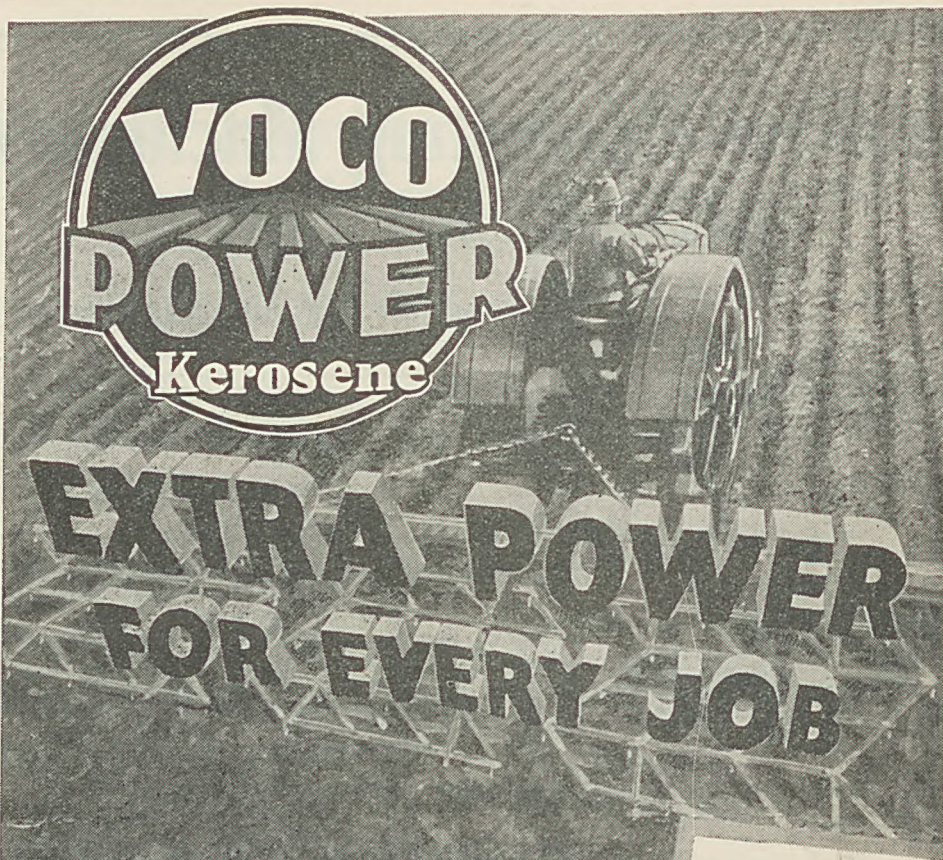
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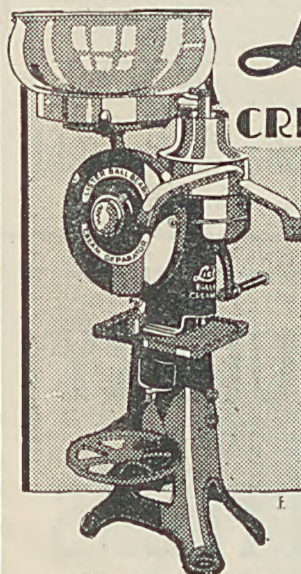
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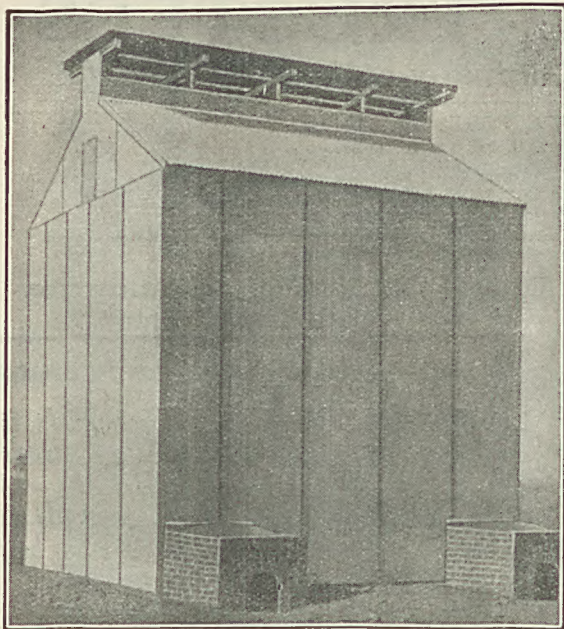
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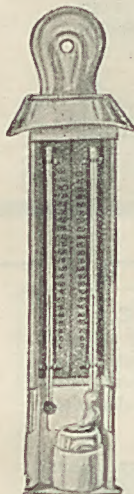
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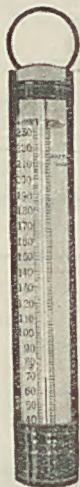


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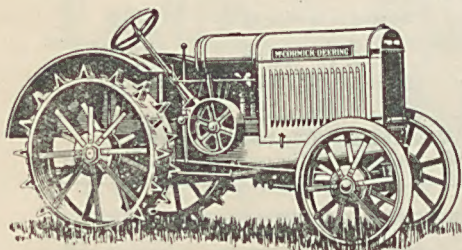
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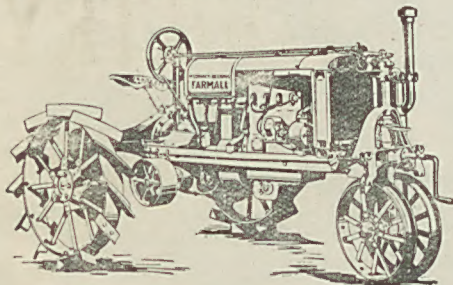
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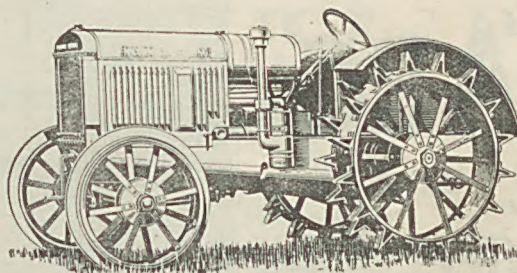
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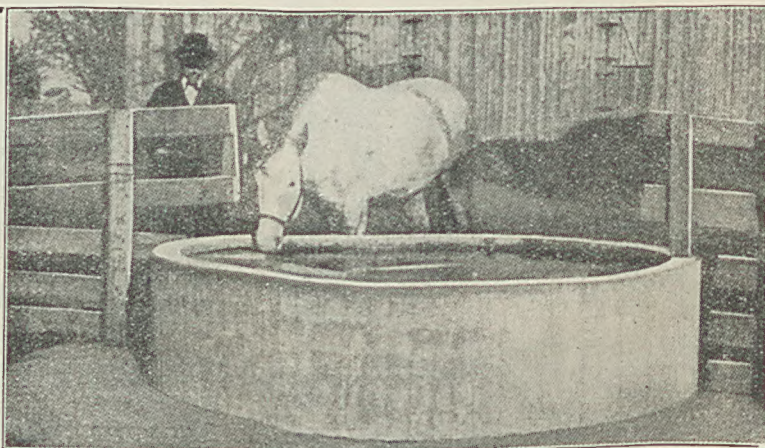
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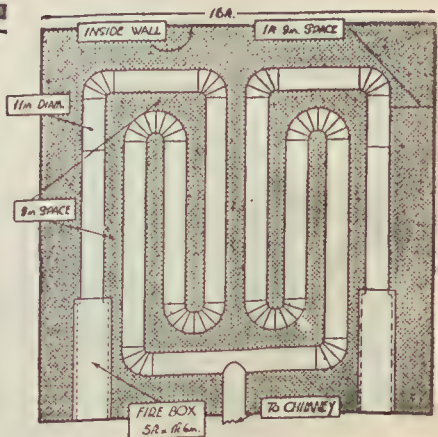
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Bacterial Blight of Beans

Its Nature and Control

By D. B. Adam, B.Agr.Sc., Plant Pathologist

THE French bean is one of Victoria's most important vegetable crops. It is grown as a field crop in many parts of East Gippsland and elsewhere in thousands of back garden plots throughout the State.

The bean crop is specially important in Victoria, because besides having a big industry in supplying the fresh green beans as a vegetable we have another valuable industry in supplying the seed for practically all the bean crops grown in the Commonwealth. This seed growing industry is centred around Orbost, which district can fairly claim to be capable of producing a quality of Canadian Wonder beans that is nowhere excelled.

The average annual production of beans in Victoria is 20,000 bushels, worth, at a conservative valuation, £25,000 to £30,000 per annum. Bean blight is a disease of French beans which on account of its prevalence two or three years ago attracted a good deal of attention, although there is good evidence to show that it occurred in milder form in Victoria for many years prior to that time.

Bean blight is the result of an invasion of the bean plant by a particular kind of germ or bacteria, just as anthrax in sheep or diphtheria in children is the result of an invasion of the animal body with other distinct kinds of bacteria. Because it is caused by bacteria the bean blight at present being considered is usually referred to as the bacterial blight to distinguish it from another, less common,

blight of beans, which is caused by a fungus.

Bacterial blight attacks all parts of the plant above ground. On the leaves an infection appears as a small water-soaked or brown spot. This is usually surrounded by a yellow halo, which gradually merges into the normal green of the leaf. The clearness and width of the halo depend a great deal on the conditions under which the plant attacked is growing. If the conditions are such that the plant is growing poorly, the spots are small and poorly defined. If the plants are growing vigorously on a rich river flat, the halo is wide, distinctive, and clear. The most certain evidence of the disease is its occurrence on the green bean pods. Here it occurs as round water-soaked spots, which give the impression that a small drop of candle grease had been dropped upon the pod. Indeed, in New South Wales the disease is often referred to as the "candle grease spot" disease, while in France the disease is named "La graisse," and the Germans give it a name which, translated, means "grease spots" disease.

In addition to these round spots a greasy band may develop along the top or the bottom edge of the bean pod. These bands may be the result of the running together of a lot of spots, and may arise as a result of a direct infection of the pod, but it is more usual for it to result from an infection of the stem with which these parts of the pods are directly

connected. This means that the bacteria causing blight sometimes get into those parts of the plant which convey the water and mineral matters necessary for the nourishment of the plant, and through these channels may travel to all parts of the plant.

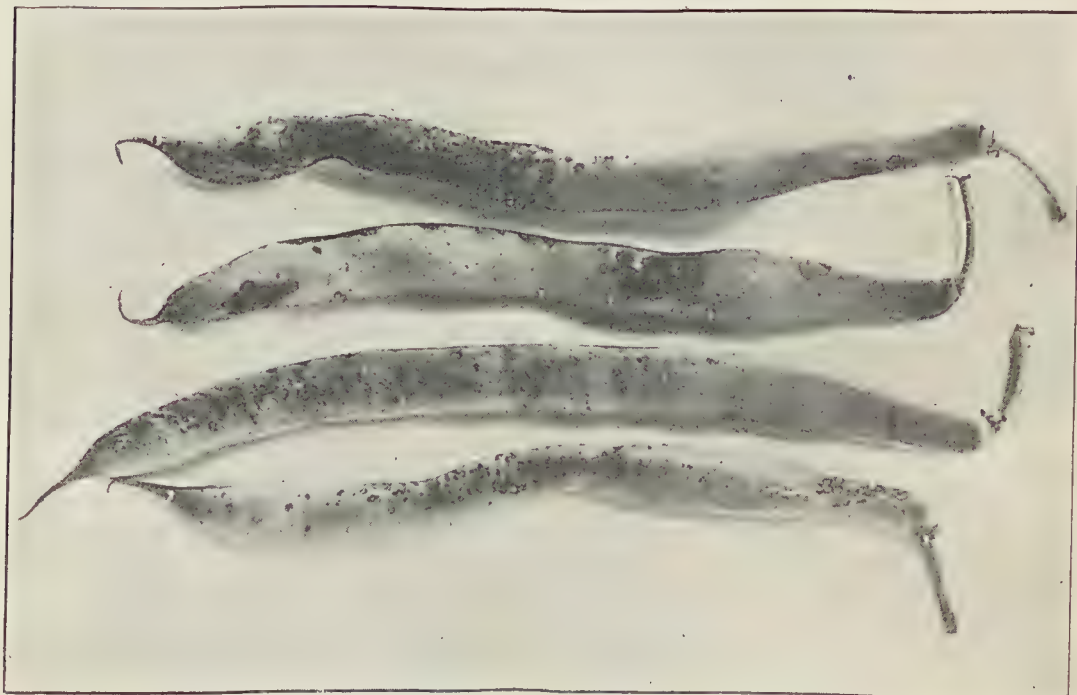
The invasion of these parts has two important results. In the first place the bacteria may accumulate to such an extent that the water conducting channels become blocked, with the result that the distant leaves wilt; and the plant eventually dies. In the second place the bacteria may travel along these channels through the pods and into the seed. In a variety like Canadian Wonder, which has dark-coloured seed, this infection of the seed may occur without it showing any sign of the disease. In certain white-seeded varieties, such as Magnum Bonum, infection appears as small, yellowish, varnish-like spots.

This question of seed infection, the natural occurrence of which is undoubted, is worth a little special consideration. From the viewpoint of the bacterium the establishment of seed infection is a master stroke, because with the development of the young seedling the bacterium ensures its having close handy a plant which it can attack. The bacteria make good use of their opportunities. Undoubtedly



Bean Crop affected by Bacterial Blight.

a very great proportion of the early infections occurring each season start from infected seed which has been planted. For Victoria, as the bean-seed producer, this fact of seed infection entails a great responsibility which we are bound to face. How best this can be done will be discussed after a short account of the development of the disease in the field has been given.



French bean pods showing typical "grease" spots.



On the left, a clean bean plant; on the right, bean plant affected by Bacterial Blight.

When an ordinary sample of bean-seed is sown, 95 to 99 per cent. of the seedlings that grow may be quite healthy, the remaining small percentage of plants having small water-soaked spots on the more or less yellowed first leaves. These infected seedlings have developed from infected seeds; they serve as sources of infection to healthy neighbouring plants, but are seldom numerous enough to make the ordinary grower believe that he has anything but a perfectly healthy crop. The subsequent spread of the disease from these infected seedlings is wholly a matter of weather conditions. If the season is unfavorable to the spread of the disease, very little development occurs, and the disease may pass unnoticed. On the other hand, with favorable conditions, the disease may spread so rapidly from these few infected seedlings that the crop is destroyed.

First and greatest in importance in favouring the spread of the disease is the occurrence of windy, wet weather, especially during the early stages of the growth of the crop. The driving rain associated with these conditions carries the germs from the surface of infected seedlings and deposits them on the surface of their healthy neighbours, which they then proceed to infect. These plants ultimately

serve as fresh centres of infection, and so the disease area expands. Since these stormy periods can be expected to occur less frequently as we approach summer, the precaution of planting beans at a later date than was done formerly is a wise one where, as is the case with Orbest seed crops, earliness of the crop is not essential. Under these conditions, with a given amount of seed infection, it is reasonable to expect less spread of disease in a crop. The fact that wet windy weather is necessary for the spread of this disease means that in districts where these conditions are absent and where water must be artificially applied by irrigation, the disease, although possibly present occasionally in a few seedlings, does not become established, and a healthy crop from which healthy seed can be obtained is harvested.

Let us return to the problem of the local bean growers. He has to accept the seed that is available. There is usually a good market for early green beans, and growers who are in a position to do so desire to grow beans to catch this market. They cannot postpone planting in the hope of meeting better weather, but they can reduce their losses a great deal by a judicious selection of sites. They should select for the early plantings the areas best

protected in the direction from which wet squally weather usually comes, reserving the more exposed fields for the later crops. The exercise of a little thought in this direction will be well repaid.

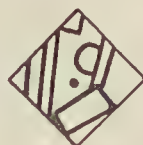
Under field conditions it has been observed that crops grown on light sandy soil suffer more severely from the disease than those grown on rich river flat land. In line with this observation claims have been made that the application of sulphate of ammonia or similar manures on this class of land eliminates the blight. Last year this claim was tested in some Departmental plots at Orbost, but no such beneficial results were obtained. On some classes of land there may be an apparent benefit, not so much because it has made the plants resistant to the disease so much as because it makes the plant vigorous in spite of the disease.

A second factor which determines the extent of the disease spread is the variety of bean planted. Some varieties, like the Canadian Wonder, are very susceptible to the disease, and it spreads quickly in them. No variety of French bean is known to be immune from this disease, but certain so-called fancy varieties, such as Pale Dun or Feltham's Prolific possess some degree of resistance, and the disease does not spread so rapidly through them. Home gardeners who wish to grow early beans, and therefore grow them at a time when the conditions for the spread of disease are most favorable, may wish to try either Pale Dun or Feltham's, but commercial growers are advised to satisfy themselves as to the market prospects of these beans before they venture into them on a large scale. The varieties are not as prolific as the Canadian Wonder, nor are the pods as large and fleshy, and hence, if good Canadian Wonders are available, not likely to be in such strong demand.

From what has been said it is clear that by selecting a well protected planting site, withholding planting till the risks of squally weather are reduced to a minimum, and by

using the more disease resistant varieties, the damages and consequent losses from bean blight can be reduced. All these precautions would be unnecessary were it possible to obtain a plentiful supply of disease-free seed. The Department of Agriculture, in the belief that the development of supplies of disease-free seed is the crux of the problem, has devoted special attention to it. In pursuing this problem, two lines have been followed. The first has been the establishment of a number of experimental plots in the heart of the seed-growing section at Orbost. The plots were instituted last season, and are being continued again this year. The plots last year were designed to discover whether there were any strains of Canadian Wonder beans quite free from infection with bacterial blight, and to test the effect of different times of sowing, heat treatment of seed, manurial treatment, spacing of plants, and pulling out of diseased plants, on the amount of disease occurring in the crop at the end of the season. This year it is proposed to find out what effect the various measures taken have on the disease in the seed treatment trials, using a number of new materials that have given promise in laboratory tests, and to continue the trials with various spacings of plants and the pulling out of diseased plants as soon as they appear. In the second place, efforts are being made to assist buyers in the purchase of disease-free seed by the institution of a bean seed certification scheme. Where certificates are granted it will indicate to the buyer that the crop from which the bean seed was harvested was free from bacterial blight, which is the best possible guarantee that he can have that the seed is free from infection.

By setting a standard in the very important quality of freedom from disease, this scheme will help the general body of bean-seed growers by providing a goal at which to aim. Actually there is ample evidence that very many of the bean-seed growers already feel the challenge of this disease, and are taking every precaution at present available to secure clean crops.



The Sheep Industry

Helpful Hints to Sheep-men

7.—Worms in Sheep.

By S. A. Mountjoy, L.V.Sc., Veterinary Officer.

[Previous articles of this series, which appeared in the June, July, August, September, November, and December issues of the Journal, dealt with the selection of ewes and rams, lamb marking, classing the wool clip, fat lamb raising, the sheep blowfly, and foot-rot.]

Of all the domestic animals, sheep are the most subject to serious infestations with animal parasites such as worms, and it not infrequently happens that heavy mortality directly attributable to internal parasites may occur in flocks. Even when there is no mortality, the presence of worms may mean great economic loss to the sheep-raiser, for infested sheep usually are reduced in condition, and then fleeces are appreciably lighter than those of healthy sheep.

Healthy, well nourished, adult animals exhibit a marked natural resistance to worm infestation. During early life this resistance is not developed to a great extent, so that the more serious effects of worms are frequently seen amongst lambs and young sheep. When exposed to infestation, animals which are experiencing a drain on their vitality such as pregnant or nursing ewes, and ill-nourished sheep, show a lowered resistance to the harmful effects of internal parasites.

Worms usually occur amongst sheep which have access to swampy lands or heavy pastures which remain damp for long periods, although these conditions are not essential. Old pastures, especially those that have been overstocked, are particularly dangerous on account of the gross contamination with young immature worms which have accumulated.

Generally a worm injures its host in one of four ways—

- (1) By robbing it of blood, or of food which has not yet been digested;
- (2) by mechanical injury and obstruction;
- (3) by the production of toxic excretions or secretions which are absorbed by the host; and
- (4) by producing lesions whereby bacteria may enter the tissues.

STOMACH WORMS.

Stomach worms are found in the fourth stomach, and there are two forms of importance in Victoria—(1) *Haemonchus contortus*, and (2) *Ostertagia circumcincta*, the former being the less common.

Haemonchus contortus is from $\frac{3}{4}$ inch to $1\frac{1}{2}$ inches in length, and is a blood-sucking round worm. Its alimentary canal shows red through the thin body wall, and in the female the white genital tubes are coiled spirally around the alimentary canal, giving it the appearance of a "barber's pole."

Life History.—The mature female lays a large number of eggs, which are passed out in the dung. Freezing or desiccation will kill the eggs, but, if the temperature be favorable, they soon hatch out. The immature worms when hatched increase in size, undergo two changes in structure, and eventually crawl on to a blade of grass, where they remain dormant until eaten by a sheep, in the stomach of which they attain maturity in from two to three weeks.

The resistance of the young worms, before being eaten by sheep, is very great. They can stand the cold of winter without suffering any harm, and if conditions are favorable may remain alive on pastures for about ten months.

Ostertagia circumcincta is a small, hair-like, blood-sucking worm, from $\frac{1}{4}$ inch to $\frac{3}{4}$ inch in length. These small worms are difficult to see, but a method which will result in their ready detection is to scrape the surface of the fourth stomach with a knife, place the scrapings thinly between two pieces of clear glass, and hold up to the light, when they may be seen as small hair-like structures. Post-mortem examination should be made as soon after death as possible, as these small worms soon disappear once putrefaction sets in.



Stomach Worm.
(*Haemonchus contortus*.)

A.—Male. B.—Female. C.—Egg.

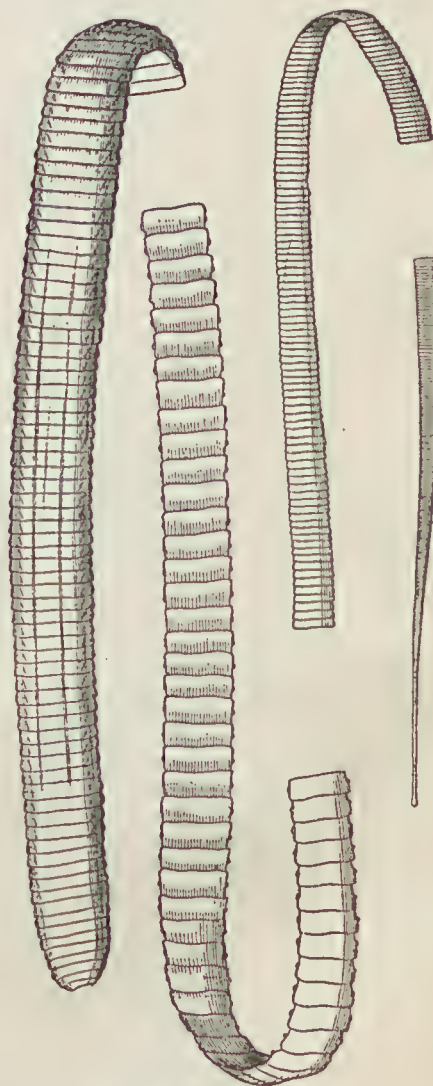
The life history of *Ostertagia circumcincta* probably is the same as that of *Haemonchus contortus*.

INTESTINAL WORMS.

(1) *Round Worms*.—The round worms infesting the small intestines of sheep are represented by many species of small hair-like worms, which, with the exception of *Zematodirus filicollis*, are similar in size, or smaller, than *Ostertagia circumcincta*.

Nematodirus filicollis is usually slightly reddish in colour, about $\frac{1}{2}$ inch to 1 inch in length, and is found in the first part of the small intestine. This worm, in conjunction with *Haemonchus contortus*, causes Lincolnshire lamb disease, a condition responsible for heavy mortality in sheep in various parts of England. These intestinal round worms may be found in conjunction with either or both of the common stomach worms, although cases occur where the serious infestation is represented by a predominance of the intestinal forms.

In the large intestines occur two main species of *Oesophagostomum*. *Oesophagostomum columbianum*, a white, fairly thick worm, from $\frac{1}{2}$ inch to 1 inch in length, causes a nodular disease of the intestine, known to butchers as "Pimply Gut." The young or larval worms on reaching the small intestine bore into the wall and cause small shot-like nodules, in which they pass through three stages, eventually leaving the nodules to become mature in the large intestine.



Tapeworms (natural size).
(*Moniezia expansa*.)

[Reproduced from *A Treatise on the Parasites and Parasitic Diseases of the Domesticated Animals*, by J. G. Neumann.]

Another species, *Oesophagostamum verulosum*, is not associated with the formation of intestinal nodules during its development, but it is now considered that the adult forms of this parasite are extremely harmful. Both of these worms are rare in Victoria.

Other forms found in the large bowel of sheep are *Chabertia ovina* and *Trichuris ovis*. *Chabertia ovina* is a stout white worm, which is readily seen in the large bowel, and is usually found adhering to the bowel lining by its mouth. *Trichuris ovis*, the whip-worm, so called because of its resemblance to a stock-whip, is found in the caecum and large intestines. Unless present in exceptionally large numbers, these two varieties are not associated with disease in sheep.

(2) *Tapeworms*.—There are two tapeworms of importance found in the small intestines of sheep in Australia, viz., *Moniezia alba* and *Moniezia expansa*. These are long, yellowish-white, ribbon-shaped, segmented worms, measuring from 2 to 10 yards in length.

When ripe, the end segments, which are filled with eggs, break off, and are passed out with the droppings, and serve as a diagnosis of the presence of the infection. Their life history is unknown.

Symptoms of Worm Infestations.

In some cases no symptoms at all are noticed. Usually the first symptoms seen are that the animals appear less lively, lose condition, and remain stunted in development. If examined, the membranes of the eyes and mouth will be seen to be paler than normal. Later on, diarrhoea, with occasional attacks of colic, sets in, and swellings may appear below the jaws. In some cases convulsions and paralytic conditions are shown. The animals become extremely emaciated, and the mortality may be heavy.

Treatment.

For the treatment of stomach and intestinal worms, including tapeworms, copper sulphate (bluestone) and nicotine

sulphate solution, when properly administered, has been found to be a safe medicine, and one from which good results may be obtained. Treatment should be carried out not only to cure affected sheep, but also to reduce the amount of infestation from year to year.

As mentioned in the life histories of the various worms, infestation takes place through sheep eating grass on which the immature forms of the worms are encysted. Infestation may also be brought about by sheep drinking water which contains the larval forms. Sheep, when returned to pasture after dosing, may thus be reinfested, especially during the spring and summer months. In the case of severe infestations a second dose may be given in a fortnight. Young sheep and lambing ewes are more liable to suffer harmful effects from an infestation, and efforts should be made to prevent this by carrying out treatment with copper sulphate and nicotine sulphate every four weeks through the spring, summer, and autumn months. Dosing should be commenced as soon as the grass begins to grow. By this method the young worms are destroyed before they can lay eggs to reinfest the pasture.

It is not advisable to drench ewes and lambs at the same time. Ewes should be treated first, and the lambs a week later.

The animals must not be allowed any food, if possible, for 36 hours before dosing, and no



Left—the wrong way to drench a sheep. Too little or too much may be poured at one time, resulting in the animal being strangled. At right, the correct method. Let the dipper drop into the funnel and gradually pour out the dose, keeping your eyes on the animal.

water should be given for two hours after administration of the medicine. Treatment should be commenced before sheep become too weak to withstand a 36 hours' period of fasting. Those unable to stand this probably would die in any case.

PREPARING THE SOLUTION.

Use porcelain or enamelware utensils in preparing and administering the solution, as the copper sulphate will corrode ordinary metal utensils.

Make up a stock solution as follows:—

Dissolve 2 oz. of copper sulphate (bluestone) in $\frac{1}{2}$ pint of boiling water, then add enough cold water to make a total of 1 gallon (160 oz.). To this add 2 oz. of nicotine sulphate 40 per cent. (Black leaf 40). In dissolving the copper sulphate, all white or powdery lumps should be discarded, and only hard blue lumps used.

The doses suggested are—

For adult sheep—2 oz. (4 tablespoonfuls).

For sheep 12 months old—Three parts of stock solution and 1 part water; give 2 oz. as a dose.

For lambs 6 months old—1 oz. of stock solution.

For lambs 3 months old—One part of stock solution and one part water; give 1 oz. as a dose.

Special drenching funnels or the following apparatus may be used for administering the dose:—An enamelware bucket to hold the solution; an enamelware funnel, about 5 inches wide at the top, to which is attached about $3\frac{1}{2}$ feet of rubber tubing with an inside diameter of $\frac{3}{8}$ inch, the end of which is fitted with a brass or copper nozzle 6 inches long and $\frac{3}{8}$ inch inside diameter.

A measure with the dose accurately marked should be used for pouring the dose into the funnel.

The sheep should be drenched standing on all four feet, and the nose held about level with the eyes by an attendant who, with his right hand, passes the nozzle through the side of the animal's mouth over the tongue between the back teeth. He holds the head in position with the left hand, the four fingers of which are placed under the jaw and the thumb over the nose. The jaws should not be gripped tightly.

The person dosing should hold the funnel well above the sheep's head and pour the dose in slowly. The head should be lowered immediately if the sheep begins to cough.

LUNG AND BRONCHIAL WORMS.

Lung worm disease is fairly common in this State. The disease may appear in a flock at any time, but usually it occurs from early spring to late autumn. Frequently stomach and intestinal worms also are present at the same time as lung worms. There are several species that may infest sheep.

The more important in Victoria are—The *Bronchial Worm* (*Dictyocaulus filaria*) and the *Lung Worm* (*Muellerius capillaris*). The latter is a fine, hair-like, brownish-red worm, about $\frac{3}{4}$ inch to $1\frac{1}{4}$ inches in length, and is found in nodules in the lung tissue.

Dictyocaulus filaria is a white, hair-like worm, from $1\frac{1}{2}$ inches to $4\frac{1}{2}$ inches in length, and is found packed in the smaller bronchioles at the base of the lung.

The life history of this worm is as follows:—

The female lays an egg containing an embryo, and the young worms hatch in the bronchial tube. They are coughed up or crawl up to the pharynx and are swallowed, and, passing through the stomach and bowels, are liberated with the droppings. On the ground they undergo two changes in structure, and then crawl on to a blade of grass, where they remain in a more or less resistant stage. When



The Bronchial Worm.

(*Dictyocaulus filaria*.)

A.—Male. B.—Female.

(Natural size.)

The Lung Worm.

(*Synthetocaulus rufescens*.)

Male and Female.

[Reproduced from *A Treatise on the Parasites and Parasitic Diseases of Domesticated Animals*, by L. G. Neumann.]

swallowed by sheep grazing, the young worms (their coat digested) pass into the fourth stomach. They then bore through the bowel wall and make their way to the lungs, which they enter by boring through the lung tissue to the bronchioles, where they enlarge and grow to sexual maturity.

The life history of the lung worm (*Mel-lerius capillaris*) is probably much the same as the above.

Symptoms.

The first thing noticed is a cough, which at the start occurs only in a few animals; it is short, dry, and strong. Gradually most of the flock will be noticed to be affected with this cough. As the disease progresses the cough becomes more frequent, but weaker. The

bronchial secretions (in which are found the worms) are expelled through the mouth in lumps. There is also a mucus secretion from the nostrils. Breathing becomes more and more difficult. The sheep become emaciated, and the membranes of the eyes, nostrils, and mouth become pale. After a period of from about two to four months death may occur from exhaustion. Mortality varies according to the severity of the infestation; occasionally it may be very heavy, reaching as high as 70 per cent.

Treatment.

Treatment of lung worm disease is rather unsatisfactory, and in most cases good food and care probably will give better results than medicinal treatment. Drenching with copper sulphate (as described before) should be carried out, as this, besides destroying stomach and intestinal worms, which are almost invariably present, may also destroy any larvae of the lung worms present in the stomach and intestines. In the case of valuable stud sheep, intratracheal injections may be tried, but as this treatment requires skill it should be carried out only by a qualified veterinary surgeon.

Control of Worm Infestations.

1. All dams and watering places should be fenced off, and troughing supplied for stock to drink from. Troughs should be cleaned regularly.

2. Low-lying swampy pastures should be drained or fenced off.

3. A burning off of worm-infested pasture is one of the best means of destroying the young worms, and should be carried out where practicable.

4. After medicinal treatment, sheep should be moved to fresh pasture, and if possible the paddock just vacated should be left free of sheep for twelve months, during which time it may be cultivated with advantage. Where this is not possible, frequent changes of pasture will be of assistance.

5. Over-stocking should be avoided. The more worm-infested sheep graze over a particular pasture, the greater will be the amount of contamination with eggs and young worms.

[Continued on page 21.]



Sheep's Lung showing exceptionally heavy infestation with Thread Worms.

Part of the lung and the mucus surrounding the worms have been removed so that they may be seen in position in all tubes of the lung.

[Reproduced from the Journal of the Ministry of Agriculture (Eng.).]

Packing Tomatoes

By

B. P. Krone, Fruit Packing Instructor

THE accompanying chart (Chart I.) has been specially designed for packing tomatoes in the "long" bushel case, of which the inside measurements, clear of the division, are 26 inches x 6 inches x 14½ inches.

The counts shown on this chart are as easily packed as apples. At least eighteen different counts are used for apples, while ten counts are ample for tomatoes.

Tomatoes should be packed not lower than ½ inch, nor higher than 1 inch above the top of the case before lidding. It is preferable to pack

tomatoes the maximum height and delay the lidding process until the last possible moment.

The correct placing of the first layer is the most important factor in securing correct height.

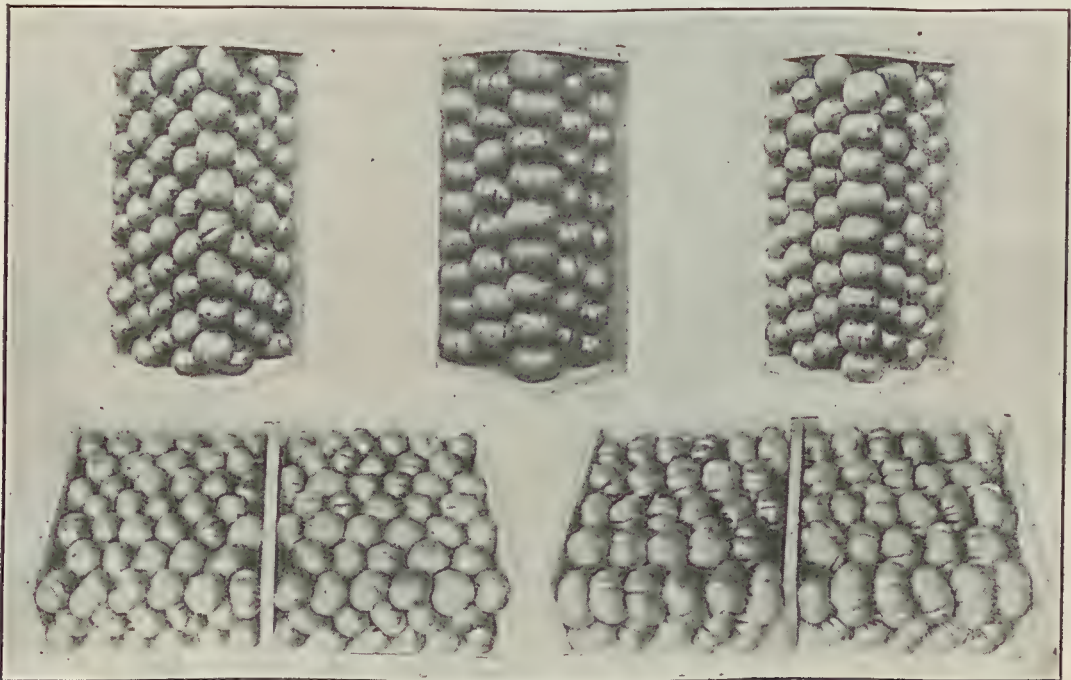
It is the size of the "pockets" or spaces that regulates the height of the fruit.

No two fruits rest directly on top of each other in any direction.

Packing fruit to the correct height in the case and the "snugness" of the specimens in each layer are the important features for its safe carriage over long distances.



An Attractive Case.



Top row.—Tomatoes packed in the "Half-dump" case. Left, the 3-2 pack, showing the 160 count; centre, the 2-1 pack, showing the 77 count; and right, the 2-2 pack, showing the 144 count.

Bottom row.—Tomatoes packed in the "Long Bushel" case. Left, the 2-1 pack, showing the 232 count; and right, the 1-1 pack, showing the 110 count.

White lining paper and new fruit cases enhance the value of the fruit. Dirty cases lined with newspaper should not be used.

Grade for colour; don't pack green and coloured fruit in the same case.

The diameter of the tomato is measured from cheek to cheek, not from stem to eye.

Slack packing bruises tomatoes. Squeezing ruptures the cells inside, causing early breakdown.

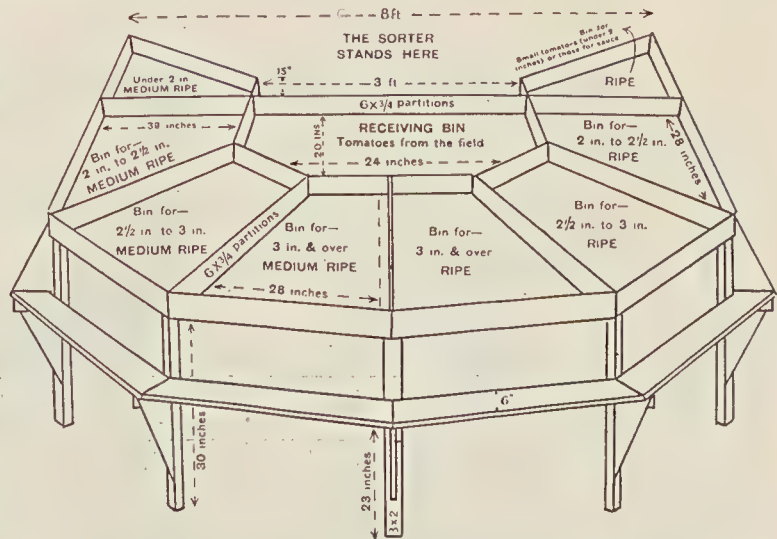
Ripe.—Means that tomatoes should be from two-thirds full coloured.

Medium Ripe.—Tomatoes should be from one-third full coloured.

Branding.—Brand initials and surname, or registered brand; the locality of production; also the quality and size standard, such as—*W. G. Thomas, Echuca, Medium Ripe, 3 inches and over.*

Charts II. and III. have been specially designed for tomatoes packed in the "half-

dump" case, the inside measurements of which are 18 inches x 8 $\frac{3}{8}$ inches x 7 $\frac{1}{8}$ inches. Chart II. is for cases made on the wide system, and Chart III. for cases made on the narrow system.



Sketch showing construction of and method of using a useful type of grading and packing bench for tomatoes.



The grading and packing bench illustrated above in use by Messrs. T. I. Smith and Sons, Portland.

CHART I.—FOR TOMATOES IN THE "LONG" BUSHEL CASE.

26 inches x 6 inches x 14½ inches, inside measurements, clear of the division.

Approximate Size.	Pack.	Layer.	Layers.	Total.	Remarks.
Inches. ..	2-1	7 x 7	7	294	Angle pack
2¼	2-1	7 x 6	7	274	Angle—small to medium 2¼ inches
	2-1	6 x 6	7	252	Angle—medium to large 2¼ inches
2½	2-1	6 x 5	7	232	Angle—average 2½ inches
2¾	2-1	5 x 5	6	180	Angle—small to medium 2¾ inches
	2-1	5 x 4	6	162	Angle—medium to large 2¾ inches
3	2-1	4 x 4	6	144	Angle—average 3 inches. Pack more loosely than usual. Reverse the first two tomatoes
3¼	1-1	5 x 5	6	120	Angle—Average 3¼ inches. Pack more loosely than usual
3½	1-1	6 x 5	5	110	Angle—small to medium 3½ inches
	1-1	5 x 5	5	100	Angle—Medium to large 3½ inches
3¾	2-1	3 x 3	5	90	Stylar to side—average 3¾ inches

CHART II.—FOR "HALF-DUMP" CASES MADE ON THE WIDE SYSTEM.

Approximate Size.	Pack.	Layer.	Layers.	Total.	Remarks.
Inches. ..	3-2	9 x 9	4	180	
	3-2	9 x 8	4	170	
2¼	3-2	8 x 8	4	160	
	3-2	8 x 7	4	150	
2½	3-2	7 x 7	4	140	
	2-2	9 x 9	4	144	Flat shape varieties
	3-2	7 x 6	4	130	Pack more loosely than usual
	2-2	9 x 8	4	136	Flat shapes. Pack more loosely
	3-2	6 x 6	4	120	Pack more loosely than usual
	2-2	8 x 7	4	120	Pack more loosely than usual
	2-2	8 x 8	4	128	Flat shapes. Pack more loosely
	2-2	7 x 7	4	112	Pack more loosely than usual
2¾	2-2	7 x 6	4	104	Pack more loosely than usual
	2-2	6 x 6	4	96	Pack more loosely than usual
	2-2	8 x 8	3	96	Flat shape varieties
	2-2	8 x 7	3	90	
	2-2	7 x 7	3	84	
3	2-2	7 x 6	3	78	
	2-1	9 x 8	3	77	Flat shape varieties
	2-2	6 x 6	3	72	
	2-1	8 x 8	3	72	
3¼	2-1	8 x 7	3	68	
	2-1	7 x 7	3	63	Pack more loosely than usual

[Continued on page 24.]

Certified Rye Grass Seed

Particulars of New Zealand Scheme

THE following outline of the essential points of the ryegrass seed certification scheme undertaken by the New Zealand Department of Agriculture is published for the information of growers.

Under this scheme there are two main classes of certified perennial ryegrass seed:—

- New Zealand Perennial Ryegrass Certified Mother Seed, and
- New Zealand Perennial Ryegrass Certified Permanent Pasture Seed.

Mother Seed.

Mother seed is intended specifically for the sowing of areas to be used for further seed production. The following conditions must have been complied with before seed may attain to the mother class:—

1. The pasture from which the seed was harvested must be 5 years old or over, and a sample of seed from that pasture must have been under test and found to be of a sufficiently high standard to warrant the pasture being declared a "Mother Seed Area."
2. At the annual field inspection the seed crop must attain the standard laid down for mother seed.
3. The machine-dressed seed must attain a reasonable standard of purity.

Permanent Pasture Seed.

Permanent pasture seed is recommended for the sowing of pastures not intended specifically for seed production. The following conditions must have been complied with before seed may attain to the permanent pasture class:—

1. (a) The area from which the seed was harvested must have been sown down with mother seed, or
- (b) A sample of seed from the area must have been under test and found to be of a sufficiently high standard to warrant the pasture being declared a "Permanent Pasture Seed Area," or

- (c) The seed must have been harvested from certain approved areas in the Hawke's Bay and Poverty Bay districts which are 5 years old or over, but from which no trial report is available. (The majority of these areas are old pastures entering certification for the first time and are subject to re-classification as Mother Seed.)
2. At the annual field inspection the seed crop must attain the standard laid down for permanent pasture seed.
3. The machine-dressed seed must attain a reasonable standard of purity.

FIRST HARVEST SEED.

In the past there has been expressed some doubt as to the type purity of First Harvest Seed, i.e., of the first year seed crop harvested from an area sown with Mother Seed. Such seed originally formed a third class, but as in no case has first harvest seed been found to fall below the permanent pasture standard, this distinction has now been removed. All first harvest seed is included in the permanent pasture class, but the tag and insert clips have stamped across them the words "First Harvest Seed". Even this distinguishing mark is likely to be dispensed with, if first harvest seed maintains the standard it has reached in the past.

Identification of Certified Seed.

Certified seed carries within the sack an insert slip, and on the outside a certification tag. The twine used for sewing the mouth of the sack is threaded through the certification tag and the ends sealed with metal seals. On the tag is recorded the registered area from which the seed was harvested, and also the number of the purity and germination certificate covering that particular line of seed.

"HB/156-D" would mean that the seed in question was harvested from paddock D, on the farm with the registered number 156 and situated in Hawke's Bay.

[Continued on page 17.]

Table Poultry

Export Possibilities

By W. C. Rugg, Chief Poultry Expert.

FARMERS in the United Kingdom have been recognized for generations past as being the leading breeders of all kinds of domestic live stock, including poultry. As agriculturists, they are producing more and more from the land under cultivation than ever before. Yet, despite the very great increase in production, Great Britain's bill for imported foodstuffs has averaged well over £500,000,000 per annum for several years. The items of most concern to the Victorian poultry-farmers are eggs and poultry, and many, no doubt, will be surprised to learn that Britain's consumption of eggs last year amounted to 549,000,000 dozen, of which 259,000,000 dozen, costing approximately £20,000,000, were imported, while her bill for imported table poultry amounts to more than £3,000,000 per annum.

Nearly every country in the world is called upon to supply foodstuffs of one sort or another to the United Kingdom, and of the total foodstuffs imported into Great Britain annually foreign countries supply about 62 per cent., and the dominions about 38 per cent.

During the last few years Victorian poultrymen have captured a share of the egg trade, and provided that they ship only eggs of the very best quality, packed in an attractive manner, there is every possibility of a great increase in this business in the next few years.

Unfortunately, no serious attempt has been made by Victorian poultrymen to produce good table poultry, either for the local trade or for export. The probable reason is that egg production has been the most profitable branch of poultry farming, and those engaged in the industry here have concentrated on the breeds of poultry that give them the best return in



Breeding pen of Light Sussex owned by Mr. M. G. Leech, Campbellfield.

eggs, regardless of whether they are good table birds or not.

More than 500,000 birds for table purposes were sold in the auction rooms in Melbourne alone last year, but a very small percentage of these were marketed in good condition, and very few of them were either of the breeds or quality that would attract buyers in Great Britain. Probably at least 75 per cent. of the birds sent in for table purposes are surplus birds from farms whose main purpose is the production of eggs and consequently the principal breeds represented are White Leghorns, Australorps, and Rhode Island Reds. Several lots of these breeds have been exported from Victoria as well as from other States at different times, but have been difficult to sell in London, except at unprofitable prices.

Victorian poultrymen and exporters must realize that, if they are to obtain a share of the table poultry business in Great Britain, they must produce the class of bird the British consumer wants. The English merchant knows that the only way to make his business profitable is to please his customers. If he cannot obtain the right kind of article from any one country, he will go elsewhere, and he has half the countries of the world from which to draw his supplies. At present he imports turkeys from Ireland, France, Hungary, Jugo Slavia, Italy, Russia, South Africa, and Argentine; chickens are imported

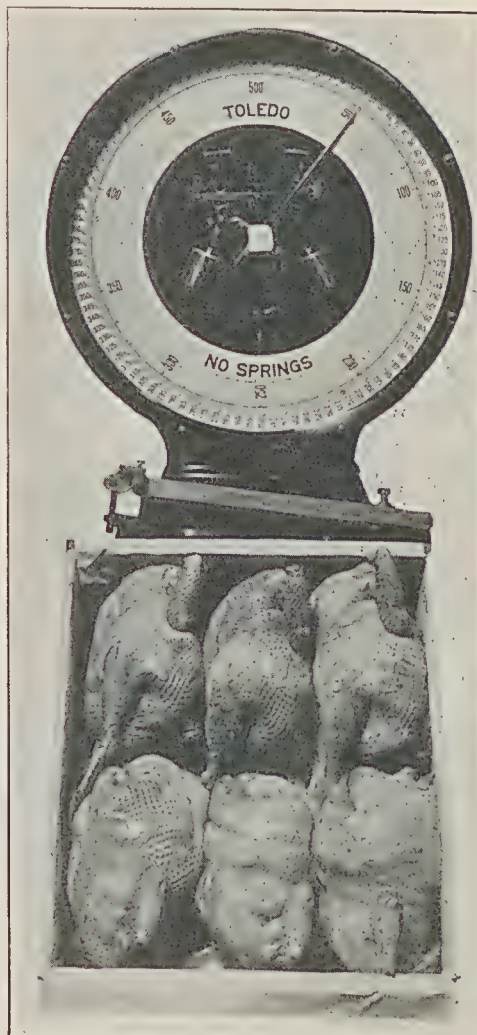
from Russia, Hungary, The Netherlands, and United States of America; ducks mostly from China and United States of America; geese from Ireland, France, and Russia; and guinea fowls from Italy and Hungary.

All of these countries have been supplying English merchants for years, and are thoroughly conversant with the requirements of their trade. That, however, is no reason why we cannot capture a share of the business. We have many things in our favour. In the first place, there is the increasing desire in Great Britain for greater trade within the Empire, and an extensive campaign with that objective in view is being carried out now. Secondly, we have a climate second to no other so far as suitability to poultry rearing is concerned. Thirdly, we produce within our boundaries all the foods necessary for their best growth and development; and, finally, we have the men capable of shipping the birds packed in the best condition and in an attractive manner. All that is necessary is that the producers should do their part, first, in breeding the class of bird demanded by the best trade in Great Britain; and, secondly, in putting the birds on the market in the proper condition.

At present, it appears that there is a good demand in the United Kingdom for three classes of poultry, which can be economically produced in Victoria. Those are chickens, hens, and turkeys. The classes of ducks in demand are Aylesbury and Pekin. Unfortunately, breeders here for some reason do not produce these varieties in sufficient quantity. The variety bred in the largest numbers is the Muscovy. Trial shipments of these to Great Britain proved so difficult to sell that the experiment has not been repeated by the exporter. Judging by the prices at auction, Muscovies are losing their popularity on the local market. Geese and guinea fowls are bred only in small numbers.

The chickens and hens that will bring the best prices on the English market are the breeds with white legs, thin, almost transparent skin, under which the white fat can be distinctly seen and a white under-feather. Amongst the breeds that possess these desirable qualities are Sussex, Buff Orpington, White Orpington, &c. Of these the most popular in Victoria are Light Sussex and Buff Orpington.

English buyers are prejudiced against birds with yellow skin legs and fat. Birds with black legs have not an attractive appearance



Light Sussex Hens packed for export by Messrs. D. Hyland & Son, Melbourne.

when dressed, and they also have an additional disadvantage in having black quills which it is difficult and in some cases impossible to remove when plucking. These black stubs detract from the appearance of the bird, even though it be well fattened and the flesh of good texture; in fact, the whiter the skin and the finer the texture of the flesh, the more the black stubs show up.

In a paper read recently before the English National Poultry Parliament, Mr. A. S. Juniper, a leading authority on table poultry in England, pointed out that in the meat trade the demand for large joints was a thing of the past, and whether it was due to smaller



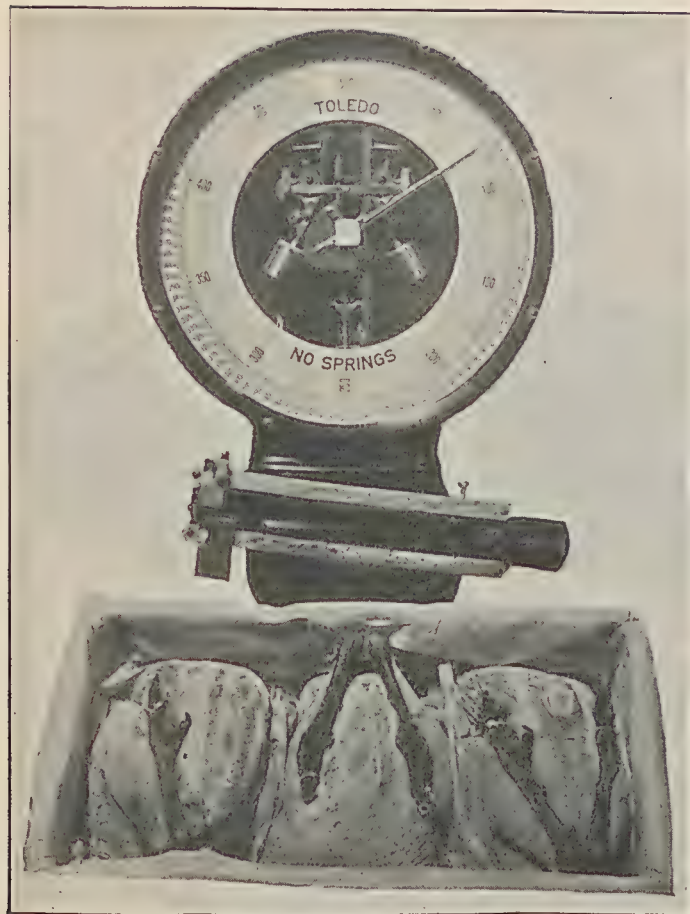
Light Sussex Cockerels packed for export.

families or reduced incomes, the same might be said of table poultry. As far as chickens were concerned, the chief demand by the high class family trade and the highest class of hotel, clubs, and restaurants was for chickens from $3\frac{1}{2}$ to $4\frac{1}{2}$ lb. heavier chickens meeting a limited demand. In the large industrial areas throughout the country there was a great demand for chickens weighing 2 lb. to 3 lb. He stated that a demand existed for a large and uniform supply of high quality birds, and it was important that all chickens for table purposes should be well conditioned, that is, carrying a heavy percentage of soft flesh. The concentration of the English producers since the war on the popular egg-laying strains was, he contended, one of the chief reasons why the English market had not for some years been adequately supplied with suitable birds from home sources.

This is exactly the position in Victoria. Poultry farmers have concentrated on the breeds that gave them the best returns in eggs, and have been satisfied to market their surplus cockerels and worn-out laying hens at whatever price was offered. If they arrived at the market in good condition, it was, in most cases, more by good luck than good management. For years auctioneers have been complaining bitterly of the poor condition in which most poultry are sent in. Within the next few months thousands of cockerels will be sent in from egg-producing farms. Nearly all of these will be Leghorns and Australorps which are unsuitable for export, and unless different methods are adopted than in the past, these cockerels will not bring the cost of the food they have eaten. The question arises whether, in view of the fact that poultry food prices are almost certain to increase with very little prospect of any great increase in prices for eggs, Victorian poultrymen would not be wise to carry on the production of table poultry for export as an adjunct to egg production.

There is no reason known to the writer why some of the breeds suitable for export cannot be made profitable as egg producers. The breeds that at present excel as prolific layers of eggs have been brought to that stage by careful selection, and birds laying up to 300 eggs and over are not uncommon. Flock averages of half that number of eggs will show a good profit over food costs at present prices. Light Sussex hens, while being suitable for export, are fairly good egg producers. At the last Harper Adams Egg Laying Competition in England 150 hens of that breed laid an average of 156 eggs each in 48 weeks. The winner of the single bird test, also a Light Sussex, laid 268 eggs in twelve months, only four of which were second grade. This should be sufficient to show Victorian poultrymen the possibilities of this breed as producers of eggs, with the added advantage of having at the end of their profitable life as layers, birds that, if put on the market in good condition, will be sought after by exporters, and will meet with a ready sale overseas.

A report received recently from The Empire Marketing Board outlines the results of some experiments in fattening poultry for table carried out at the Agricultural College at Wye, Kent, England. This test was to ascertain the economic value for table purposes of the breeds most generally used by commercial egg farmers as compared with the breeds and cross-



Turkey Cocks packed for export.

breeds generally regarded as best for table use. The breeds used were White Leghorns, White Wyandottes, Rhode Island Reds, Light Sussex, and the crossbreds Indian Game and Light Sussex, Silver Dorking and Light Sussex. Some of each breed were fattened by feeding in troughs, others of each breed were crammed and marketed, while some were marketed off the run. The result, the report states, was that after taking into consideration all factors such as food costs, weight gained, market value, and margin over cost, the pure-bred Light Sussex was the most profitable breed for table poultry production. The trough-fed birds were marketed at 24 weeks old, the crammed birds at 25 weeks, and the birds off the run at 22 weeks.

In conclusion, I would impress upon poultry farmers the fact that the time spent in preparing produce before sending from the farm is time well spent. No matter what is being sold, whether it be breeding stock, live or dressed poultry, it should never be sent from the farm until it is in the best possible condition. Especially is this true when produce is intended for table use or export.

Certified Rye Grass Seed

(Continued from page 13.)

"NC/298-A" would mean that the seed in question was harvested from paddock A, on the farm with the registered number 298 in the North Canterbury district, and so on, the letters HB, NC, and S, standing for Hawke's Bay, North Canterbury, Southland, &c., wherever the seed happened to be grown.

It is of great importance that purchasers should realize that certification of ryegrass seed refers to type, but gives no warranty as to purity and germination. However, the purchaser may pro-

tect himself by inspecting the certificate which accompanies each line of seed and records the percentages of pure seed and pure germinating seed, and the nature of the impurities. The certificate is held by the vendor of the seed.

The attention of this Department has been directed to a tendency for the word "certified" to be used loosely in advertising, but there should be no difficulty in distinguishing its use in this manner from its employment in a proper connexion.

Spray Residues on Fruit

Methods of Removal

By A. G. Strickland, M.Agr.Sc., Horticultural Research Officer.

THE great majority of orchardists realize that sprays of various kinds must be applied to fruit trees in order to protect the crop from the attacks of insect pests and fungus diseases. Spraying usually is carried out periodically during the early part of the growing season, and in the case of lead arsenate sprays for codling moth control may be continued up to a few weeks before fruit is harvested. It is well known that some of these spray materials may be present on the fruit at picking time, and in the past hand-wiping with a cloth has been resorted to, in order to remove the visible spray residue. In a wet summer the natural processes of growth and weathering often will remove the major part of the spray deposit and it is in a dry season that such deposits are most conspicuous. Moreover, the recent substitution of one or more oil sprays for some of the arsenical applications, and the use of combined arsenical and oil sprays, has intensified the problem owing to the binding and weather-proofing action of the oil. In many cases where oil has been used in conjunction with arsenical sprays it is impossible to remove the stain even by hand-wiping of individual fruits.



Fig. 1 Apples before washing—Arsenical residue, 0.018 grains per lb.

The presence of residues on harvested fruit may be objected to on two grounds. Firstly, the arsenical content may exceed the legal limit allowed by the British Health authorities. Under a British Health Regulation, persons offering for sale any foodstuff 1 lb. of which contains more than 0.01 grain of arsenious trioxide, are liable to prosecution. It is necessary, therefore, that our apple and pear exports should conform to this requirement. The second objection to the presence of spray residue, or, in fact, any residue such as dust or insect-specking, is that such deposits give the fruit a bad appearance. Visible deposits undoubtedly lower the market value of the fruit, and prejudice the purchaser even despite the fact that the arsenic content may be below the allowable quantity.

The problem of removing these objectionable residues is one which must be faced by Victorian growers. Quite apart from the question of British Health Regulations it must be admitted that bright clean apples and pears will receive more favour than fruits which are covered with white spray marks or any other foreign matter. Hand-wiping to remove spray deposits has been carried out extensively, but

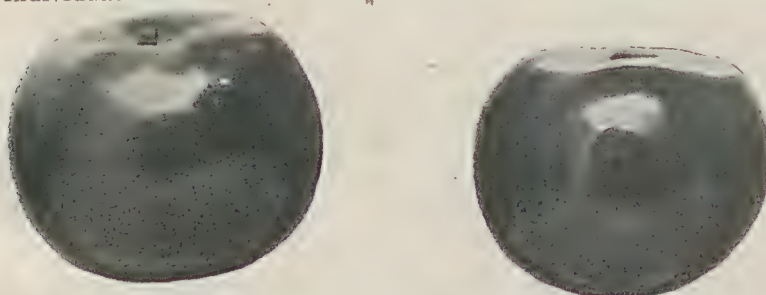


Fig. II.—Same apples after washing and wiping—Arsenical residue, 0.002 grain per lb.

even under the best of conditions it is inefficient. Such wiping does not remove residue from the cavity and basin of the fruits where the greatest concentration of arsenic usually occurs and, where oil sprays have been used in conjunction with arsenic, the method is quite inadequate. Furthermore, hand-wiping is a very costly operation, and a cheaper method is essential.

The evolution of fruit cleaning has been both fast and interesting. As an improvement on hand-wiping, the mechanical wipers and polishers were introduced. These machines are fairly satisfactory where only light residues are to be dealt with. At a later stage washing was substituted for dry cleaning and, besides being efficient in removing residues, this method results in clean attractive fruit. Various washing solutions have been experimented with, but by far the most successful is a dilute solution of hydrochloric acid. With this chemical it is possible to remove 90 per cent. of the residue without affecting the fruit. The method was tested at Harcourt on apples which were heavily coated with residue. Treatment in $\frac{1}{2}$ per cent. or 1 per cent. hydrochloric acid reduced the arsenic content from an original amount of six times the allowable quantity to approximately one quarter of the quantity permitted by regulation. Hand-wiping with a cloth and washing in water did not reduce the arsenic content to the amount required by the British Health authorities.

Hydrochloric acid is purchased in concentrated form and should contain 32 to 33 per cent. of actual acid. This commercial acid is very corrosive and must be handled with care. It attacks cloth, leather, and metals, unless quickly washed off with some alkali such as

hydrated lime or baking soda. A supply of hydrated lime or baking soda therefore should be kept handy for use in case of accident. For washing apples or pears, this concentrated acid is used at the rate of one to three gallons per 100 gallons of water, according to the density of the residue. Lightly marked fruit is cleaned quite effectively with a solution of 1 gallon of acid per 100 gallons of water, whilst more persistent residues require 2 to 3 gallons of commercial acid per 100 gallons of water.

The time required to clean the fruit depends mainly on the amount of residue present and whether or not oil sprays have been used with the arsenic. The residue is much more difficult to remove when spraying oil also is present. Usually exposure to solutions of the strength already mentioned for a period of one to two minutes is sufficient. After treatment in the acid for the required period, all excess acid remaining on the fruit must be removed by rinsing in fresh water. It is extremely important that rinsing should be thorough, otherwise there is a danger of fruit injury. Whether a machine is used, or whether the fruit is dipped in wooden troughs, it is desirable that the rinsing section should have a continuous stream of fresh water running through it. This constant change of water in the rinsing bath should take place at such a rate as to ensure the use of two to three gallons of fresh water for each bushel of fruit. After leaving the rinse bath the fruit should receive a final spray or douche of fresh water. In order to determine whether the rinsing is being conducted efficiently, it is only necessary to apply the tip of the tongue to the calyx end of the fruit after it has received its final rinsing. A sharp stinging sensation will be experienced if the rinsing has not been sufficient.

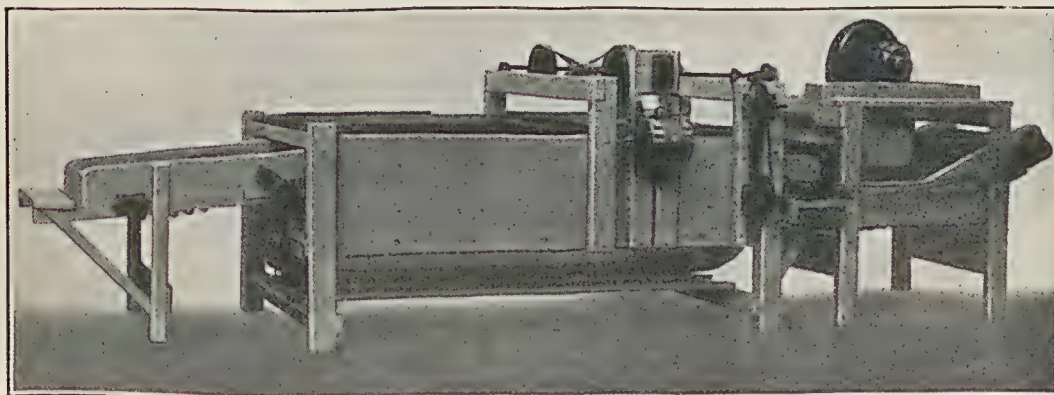


Fig. III.—One Type of Washing Machine used in U.S.A.

Where washing and rinsing have been done properly, drying the fruit does not seem to be essential, as the moisture disappears while the fruit is in storage, particularly if wrapped. Where temperatures are high in the packing shed the fruit usually will dry before packing. In the case of machines, it is usual for a drier to comprise part of the equipment—either an air blast or the passage of the fruit over absorbent towelling is effective.

Properly carried out, the treatment will not injure the fruit in any way, but, on the contrary, often will result in more attractive fruit. The first necessary precaution is to sort out all decayed fruits before washing; passage of rotten fruit through the washing or rinsing solutions will result in the contamination of these solutions with mould spores. Such contamination must be avoided because it may result in a high percentage of fruits becoming infected with storage rots.

If rinsing is not thorough, a certain amount of acid must remain on the fruit. This excess acid will collect in the stem and calyx cavities and, although it ultimately disappears by evaporation, it may persist long enough to injure the fruit. This injury appears as a bleaching of the skin, with the bleached spots later becoming depressed. If arsenic is present, the areas turn black or dark brown. Such injury is due primarily to insufficient rinsing, and usually is caused by neglect or carelessness. To avoid this trouble, two points

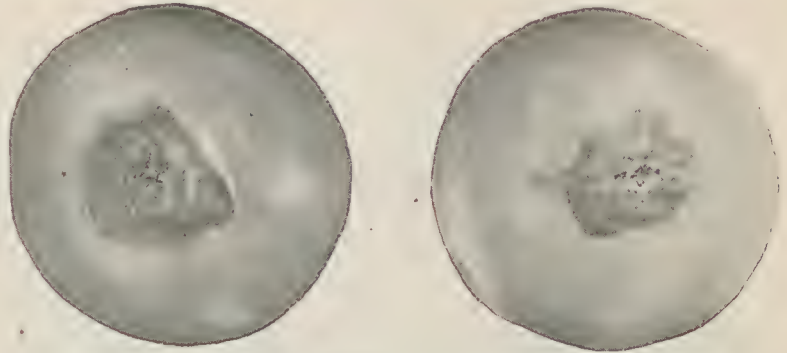
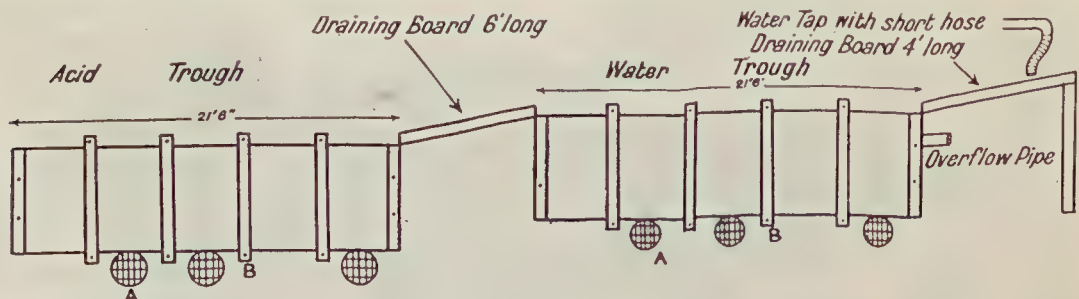


Fig. IV.—Typical calyx injury due to incomplete rinsing after acid treatment.

must be watched closely. Firstly, keep the acid up to strength. It will gradually get weaker as more fruit is treated, and should be changed for fresh solution daily. Secondly, take the utmost care in regard to rinsing, and ensure that all excess acid is removed.

A certain percentage of some apple varieties have open calyx tubes extending down to the core. Some penetration of the acid into such calyx tubes is unavoidable. Usually the penetration is negligible, but, if fruit is deeply submerged in the solution, some chemical injury, followed by decay of the core may result. For this reason machines which deeply submerge the fruit are undesirable. When fruit is hand-dipped, shallow boxes should be employed to hold the fruit, and these should be immersed only deeply enough to cover the top layer of fruit. It is advisable to use boxes containing not more than three or four layers of fruit when dipping on a small scale.

The equipment necessary for this process depends on the quantity of fruit to be dealt



A. Transverse log or plank to raise trough from ground.

B.—Batten to strengthen trough. One transverse bolt connects the batten of one side with that of the opposite side of the trough both at the top and at the bottom.

Fig. V.—Large troughs for dipping 15 cases of fruit simultaneously.

with. If large quantities are to be cleaned, as in co-operative packing sheds, the purchase of a commercial washing machine is advised. With such a machine the capacity may be up to 1000 cases per day or more if necessary. One firm in Melbourne already has drawn up plans for a suitable machine.

Where smaller quantities of fruit are to be handled, as in the case of an individual grower packing his own crop, a pair of dipping troughs will give quite satisfactory results. Such equipment consists essentially of two wooden troughs (one for holding acid and the other for water) placed end to end, with one sloping draining bench between them, and another at the end of the water trough. The size of the troughs will vary, of course, with the volume of fruit to be treated. A small grower could use ordinary washing troughs or wooden tubs in which fruit would be dipped one box at a time. A somewhat larger equipment consists of long troughs which will accommodate a number of boxes of fruit simultaneously. In this case, the boxes of fruit are floated along the acid trough and successively removed at the end, drained for a few moments on the central draining board, and then floated through fresh water. Where boxes are used as containers for dipping apples they require a loose fitting cover to the box in order to prevent

the fruit from floating out. Pears usually are too heavy to float.

The draining shelf between troughs should be long enough to accommodate half as many boxes as are being dipped simultaneously, and should slope towards the acid trough. The boxes are pushed along the acid trough at such a rate as to keep them exposed to the solution for one to two minutes. After draining for half a minute on the central board they are then pushed through the water trough. As stated before, the water trough should have a constant flow of fresh water. A final drenching with a hose is given to each box of fruit as it emerges from the rinsing bath.

Whether the washing treatment is carried out on a large or small scale, it is important that fruit should be treated immediately after picking. If washing is deferred for any length of time the fruit develops secondary wax which greatly impedes the removal of residue.

Any new practice such as the one under discussion is seldom popular at its inception. It is certain, however, that any added costs which the method may involve will be amply repaid by the improvement in the appearance of the fruit. Fruit washing is in general use in United States both for local and export purposes, and in South Africa it is now compulsory for all exported apples and pears to be washed in hydrochloric acid.



Worms in Sheep

(Continued from page 9).

6. Liberal feeding is most important. Sheep in good, strong, healthy condition can withstand the effects of a worm infestation, even though they may be harbouring hundreds of worms, whereas those in low, weak condition are unable to withstand their ill-effects, and mortality probably will be heavy. Where pastures are at all poor, hand-feeding with $\frac{1}{4}$ lb. to $\frac{1}{2}$ lb. of crushed oats per head daily should be carried out.

7. Licks should always be provided. These have little or no effect on the worms themselves, but help to maintain the sheep in good health, with the result that they are able to withstand the ill-effects of worms.

The following licks are recommended:—Salt, 60 lb.; bone flour, 30 lb.; sulphur, 5 lb.;

magnesium sulphate, 3 lb.; sulphate of iron, 1 lb.; potassium iodide, 1 oz.; and manganese sulphate, 1 oz. Or salt, 75 lb.; dicalcic phosphate, 15 lb.; sulphur, 5 lb.; magnesium sulphate, 3 lb.; sulphate of iron, 1 lb.; potassium iodide, 1 oz.; and manganese sulphate, 1 oz.

The second of the above licks will cost about £2 a ton less than the former. To mix, dissolve the required amount of potassium iodide and manganese sulphate in water and sprinkle on the salt; add the other ingredients dry and mix thoroughly on a tarpaulin or impervious floor. Finally pass the mixture through a sieve to ensure thorough mixing. The lick should be placed in boxes protected from the weather and where sheep can have free access to it.

Agricultural Lime

Its Effects on the Soil

By W. R. Jewell, M.Sc., Agricultural Research Chemist.

DURING the past year or two, there has been a marked local increase in the use of lime for agricultural purposes. The reason for this may be due partly to an awakening by the farming community to an interest in the results that may be obtained from liming, partly to the very active campaign on the part of firms marketing agricultural lime, and partly to the fact that agricultural lime is less costly per ton than fertilizers. Some farmers have erroneously thought that they could save on their fertilizers bill by substituting lime for, say, superphosphate. In this, in some cases, they have been misled by certain vendors of agricultural lime who have claimed that lime is a fertilizer and can be used in place of superphosphate. That this it not so will be demonstrated in the following remarks.

This awakened interest in agricultural lime has been reflected in the numerous inquiries received of late from farmers desirous of ascertaining whether lime is likely to be of benefit to their particular soil, whether it can replace fertilizers, and what is the best form to use. There has been a tendency on the part of a few salesmen to push the sale of lime irrespective of whether it is likely to be of value to the particular farmer, and even in districts the soils of which are already amply supplied with lime and where the addition of further lime would be equivalent to carting coals to Newcastle. Further, it would appear that in some cases extravagant claims have been made for particular brands of lime. In view of the foregoing, it would seem desirable to discuss briefly the question of agricultural lime, referring more particularly to lime itself and its various forms, rather than to the value that may be expected from liming.

Forms of Lime.

Lime may be applied to the soil in a number of forms:—

(a) As lime oxide, otherwise known as burnt lime, quick lime, caustic lime or lump

lime. This form of lime is, of course, obtained by the burning of limestone rock in lime kilns.

(b) Slaked lime or lime hydroxide, which is formed when quick lime is acted on by water either applied direct or taken up from the atmosphere.

(c) Carbonate of lime, which may be in the form of ground limestone, soft lime, marl, shells, chalk, &c.

(d) A mixture of two or more of the foregoing forms of lime. This type is not in common use but is sometimes marketed from the waste material around a lime kiln.

Lime oxide or quick lime, when applied to the soil, possibly may have an immediate deleterious action in that, because of its caustic nature, it may adversely affect organic matter and some forms of bacteria that may be present in the soil. In any case, it almost immediately reverts to slaked lime, due to the absorption of moisture either through the soil or from the atmosphere or from both.

Slaked lime is not as caustic in its action as quick lime, and because it is more soluble in water than is calcium carbonate, it may have a more rapid action on the soil and may, perhaps, be of particular benefit to heavy clay soils. Slaked lime and also quick lime rapidly absorb carbon dioxide from the atmosphere, and thus readily revert to calcium carbonate after application to the soil.

Calcium carbonate or ground limestone is, generally speaking, as suitable as other forms of lime and in some circumstances has advantages, provided it is sufficiently finely ground and reasonably free from impurities. The degree of fineness is of paramount importance when considering the suitability of ground limestone, more particularly when the source of supply is a hard, dense rock. Everyone has seen sea shells, which are really calcium carbonate, that have remained unaltered in the soil for years. In the same way, large lumps of rock limestone will be of very little value when applied as a liming material. When the source

of supply is a soft natural limestone, fine grinding it still essential, but the degree of subdivision need not be so great because, owing to the porous nature of this material, moisture can pass through the small lumps and thus hasten solution. There is evidence to suggest that limestone rock should be ground so that all the material passes through a 40-mesh sieve and that at least 90 per cent. should pass through a 100-mesh sieve. With ground soft limestone, it is desirable that all the material should pass through a 10-mesh sieve.

Relative Value of Various Forms.

We have seen that in most cases there is little to choose between the ultimate effects of various forms of lime, and as calcium carbonate properly ground is, in general, as suitable as other forms, it seems on the face of it an unnecessary expense to go to the trouble of burning it for agricultural purposes. These different forms of lime, however, contain different amounts of actual lime oxide, so it is apparent that different amounts of each will be required to supply the same amount of lime per acre and, therefore, to have the same effect on the soil. Roughly speaking, 56 lb. of burnt lime is equivalent to 75 lb. of slaked lime, and each of these quantities is equivalent to approximately 100 lb. of ground limestone. Hence, approximately 2 tons of ground limestone would be necessary to have the same neutralizing effect as 1 ton of quick lime.

It would appear, therefore, that the ultimate basis on which to assess the value of various brands of agricultural lime is the price per unit of lime oxide landed on the farm. By "unit of lime" is meant, each one per cent. of lime oxide per ton of material. For example, relatively pure burnt lime must cost no more than approximately twice as much as ground limestone if it is to be preferred to the latter. Again in some cases, very impure limestones or marls may be more economical than pure ground limestone, provided the former can be obtained at a lower price per unit of lime oxide. It is, therefore, essential that the lime content of agricultural lime should be known before it is possible to determine which of several brands is the most economical. When comparing various brands of ground limestone, if one brand contains, say, 95 per cent. of calcium carbonate and can be obtained for, say, 25/- per ton, then any other brand containing less than this amount of calcium carbonate cannot be economical unless it can be obtained

at a proportionately lower price, assuming, of course, that the degree of subdivision is suitable in both places. Samples of lime will be analysed for calcium carbonate content for farmers at the nominal fee of 2/- per sample; samples should be forwarded to the Chemist for Agriculture.

Effect of Lime on Soil.

Let us consider briefly the usual reasons for applying lime to soil:—

(a) Probably the most important effect of lime on soil is the correction of soil acidity. It has been established that many crops and plants will not reach maximum production when the reaction of the soil is lower than a certain degree of acidity. For instance, sugar beet and lucerne prefer a soil with a somewhat alkaline reaction. Wheat and most cereals do equally well over a range of soils of very slightly acid to slightly alkaline. Potatoes, on the other hand, do best in decidedly acid soil. When considering the desirability of liming, the type of crop to be grown has, therefore, some importance. Lime, of course, reduces soil acidity by neutralizing the acids present, and the amount of lime necessary will depend on the degree of acidity, soil type and the crop to be grown. The degree of acidity of a soil sample will be determined for farmers at a nominal fee of 2s. per sample.

(b) Lime may be necessary to remedy a deficiency of that material in the soil. That is to say, apart from the effect of soil reaction itself on plant growth, there may be insufficient lime present to supply the plants' normal requirements. Under these conditions, lime would be necessary apart from any correcting of soil acidity.

(c) Lime undoubtedly has a beneficial effect on heavy clay soils, in that it has a flocculating action, causing very fine particles of clay to flocculate together into larger particles, resulting in a much better physical texture. It has been claimed that lime also has a beneficial action in closing up light sandy soils, but the effect of any such action of this nature probably is negligible.

(d) Liming, by reducing soil acidity, may improve the bacterial activity in the soil, and also, to a certain extent, may increase the availability of other plant foods present in the soil.

There is little doubt but that there are large areas in Victoria that will benefit by the application of lime. Whether such benefit

will be an economical one or not depends largely on the degree of improvement and the price of lime. Most of the areas likely to be benefited lie south of the Dividing Range and more particularly in Gippsland. This naturally follows because, generally speaking, the higher the rainfall the more acid the soil. Most of our Northern soils and those of the Wimmera have an alkaline reaction already and are amply supplied with lime. With few exceptions, little result is to be expected from liming in these areas, and it seems rather amazing that salesmen should attempt to sell lime in some districts in which they have been active, and still more amazing that farmers in these districts should be persuaded to buy lime for their land. In some of our Northern soils, where sodium predominates in the clay complex, the addition of lime is not only unnecessary but may be actually harmful.

Lime not a Fertilizer.

It must be remembered that lime is of value for the reasons already outlined, but it is not to be considered as a fertilizer, nor can it take the place of fertilizers, in spite of certain types of sales propaganda to the contrary. A farmer

must realize that he applies lime to correct certain soil conditions, but if a soil is deficient in, say, phosphoric acid, no amount of lime can make up this deficiency, and some form of phosphatic fertilizer is essential, whether lime is used or not. Again, in most instances, to be of benefit, lime must be applied very much more heavily than is the case with fertilizers. Generally speaking, where fertilizers are applied in cwts., lime will be necessary in tons.

It should be noted that lime will not always give an economical return even on soils that one would expect to respond to liming. Farmers who propose to use lime are therefore advised to try a small area first and to note the results before deciding to lime on a large scale. Experimental plots which include trials with lime have been established by the Department of Agriculture in a large number of centres, and farmers should look to the experiments in their own districts or to those nearest their farms for evidence as to whether liming is likely to be economically beneficial under their conditions. For advice on lime and liming, application should be made to the Department.

Packing Tomatoes—continued from page 12.

CHART III.—FOR "HALF-DUMP" CASES MADE ON THE NARROW SYSTEM.

Approximate Size.	Pack.	Layer.	Layers.	Total.	Remarks.
Inches.					
2-2	3-2	7 x 6	6	195	Pack more loosely than usual.
2-2	2-2	9 x 9	5	180	
2-2	2-2	9 x 8	5	170	
2½	2-2	8 x 8	5	160	
2½	2-2	8 x 7	5	150	
2½	2-2	7 x 7	5	140	
2½	2-2	7 x 6	5	130	Pack more loosely than usual
2½	2-2	6 x 6	5	120	Pack more loosely than usual
2½	2-2	6 x 5	5	110	Pack more loosely than usual
2¾	2-1	9 x 8	4	102	Pack more tightly than usual
2¾	2-1	8 x 8	4	96	
2¾	2-1	8 x 7	4	90	
2¾	2-1	7 x 7	4	84	
3	2-1	7 x 6	4	78	
3	2-1	6 x 6	4	72	
3½	2-1	6 x 5	4	66	Pack more loosely than usual
3½	2-1	5 x 5	4	60	Pack more loosely than usual
3½	2-1	6 x 5	3	50	

A Profitable Ayrshire

By Alex. Mess, Senior Dairy Supervisor

AS one reads through the records of the Government Standard Herd Test one is inclined to ask the question, "What has become of all the Ayrshires?" Twenty-five years ago probably two-thirds of Victoria's dairy herds showed at least traces of Ayrshire blood, and the Ayrshire was easily the most popular of the pure breeds. Gradually, however the breed has lost its popularity. It is indeed unfortunate that, when the Standard Herd Test was inaugurated, so many Ayrshire breeders refused to submit their herds; the penalty of this obstinacy is being paid to-day.

As the name suggests, the first Ayrshires were raised in the south of Scotland. Of beautiful outline and conformation, the Ayrshire is an animal that incites admiration wherever she is seen, but, notwithstanding their fine qualities, they have lost pride of place in our State.

In Scotland Ayrshire breeders are ardent supporters of testing, and there many herds of heavy-producing cattle have been built up. Here the burden has fallen on a few, and the young Victorian farmer desiring Ayrshires is at a great disadvantage, as he must purchase the progeny of untested stock; unless he is remarkably fortunate he must try first one line of blood and then another. Happily a few breeders, such as the proprietors of the Gowrie Park, Medburn Grove, and Ben Kell herds, brought their stock under test, and showed what the Ayrshire is capable of doing when properly handled.

The champion herd in the test for 1914-15 was that of Mr. W. P. Brisbane, of Gowrie Park, and of the eleven highest-producing cows in the whole test for that year eight were Ayrshires. As this year was one of very severe drought it may be taken that the breed is both hardy and thrifty.



Dolly IV. of Glengowrie.

Some high figures recorded for Ayrshires during a 273 days' test are the following:—

Poppy of Ben Kell	..	692 lb.	butter-fat.
Linda of Gowrie Park	..	640	" "
Ida of Gowrie Park	..	605	" "
Trixie of Medburn Grove		581	" "

A Profitable Cow.

One of the most consistent Ayrshire milkers ever bred in this State is Dolly IV. of Glengowrie (599), owned by Messrs. Telford Brothers of "Hyde Park," Kyabram. Her sire was Bruce II. of Glengowrie (1509), and her dam Dolly of Glengowrie; she was born on the 26th July, 1917, and therefore is now over fifteen years old.

During the first four years that an agricultural show was held at Kyabram this cow secured first and champion prizes, and she has been twice awarded the type and utility prize at the Melbourne Royal Agricultural Show. Recently she completed her eighth year in the Standard Herd Test. Her records for those eight years are as follow:—

Year.	Lb. Milk.	Av. Test.	Lb. Fat.	Lb. Milk on LAST DAY of Test.
1921-22	8,492	4.42	375.64	22½
1922-23	9,762	4.33	428.77	31
1924-25	12,010	4.27	512.61	33½
1925-26	12,256	4.46	546.32	28½
1926-27	10,928	4.47	488.18	26½
1928-29	13,316	4.29	570.69	33½
1929-30	11,192	4.06	454.66	25
1931-32	11,772	4.19	493.22	28
Average	11,204.75	4.31	483.76	28½

Seven cows now under test in Messrs. Telford Brothers' herd are descendants of this cow, and are all doing well.

Orchard and Garden Notes

By Edward E. Pescott, F.L.S.

The Flower Garden.

A PART from the usual watering, soil stirring, and mulching, all consequent upon the summer weather, the principal work of the gardener is to provide for autumn and winter flowers.

All annuals must be well watered and kept free from such soil pests as slugs and snails by a very free use of the calcium arsenate. Dahlias, Gladioli, and Chrysanthemums should be watered and mulched. A weekly watering with ammonium sulphate, one ounce to the gallon of water, should also be given.

Now is the time to sow seeds of Stocks, Pansies, Wallflowers, Iceland Poppies, and similar plants intended to provide winter blooms. The seed should be sown in semi-shaded spots, and kept well watered.

Carnation seed may now be sown and cuttings may be taken from the old plants and set out, to produce young plants for winter and spring flowering. Old Carnation plants may be layered. This is an easy work; the shoots are lightly nicked at the base, and a hill of sand heaped around the plant, covering all of the stems. In a month or so, roots will have grown, and the young plants may be set out in the garden.

Many summer flowering plants such as Cannas, Delphiniums, Agapanthus, Crinum, and others are now in full flower. These should be encouraged by watering and mulching. Belladonna Lilies also are flowering. These plants are all very suitable for garden culture under hard conditions, as they revel in sunny positions. Belladonna Lilies should be watered freely after the flowering is finished to induce a good foliage growth.



Carnations.

The Vegetable Garden.

The main work this month is the supplying of water and manure for existing crops. Such crops as beans, tomatoes, melons, marrows, and cucumbers are all growing well, and should be freely encouraged to a quick and vigorous growth. Tips of shoots of melons, marrows, and cucumbers should be cut back to force lateral growth for fruit production. Seeds of French beans may be sown for late crops, and late tomato plants may also be planted out.

The Orchard.

One of the most important of orchard duties, and one of the most neglected, is the question of orchard sanitation. At this season of the year, and later, it is too frequently seen that old, decaying, or rejected fruit is left on the ground to dry, and consequently scatter any disease that may be prevalent. Codlin moth affected fruit, fruits covered it may be with black spot or with scale insects, are left lying around; dried stone fruits that have been killed by brown rot are also sometimes left on the trees. It is very urgent that all useless and diseased fruit should be gathered and burned, so as to minimize future attacks.

Then there is the question of weeds, especially flowering weeds; these all harbour thrips and Rutherglen bugs, as well as other minor insect pests. Regular cultivation will kill the weeds, and reduce the numbers of these pests considerably.

Artificial Fertilizers Registered for 1933

Analyses and Unit Values

By Will C. Robertson, Chemist.

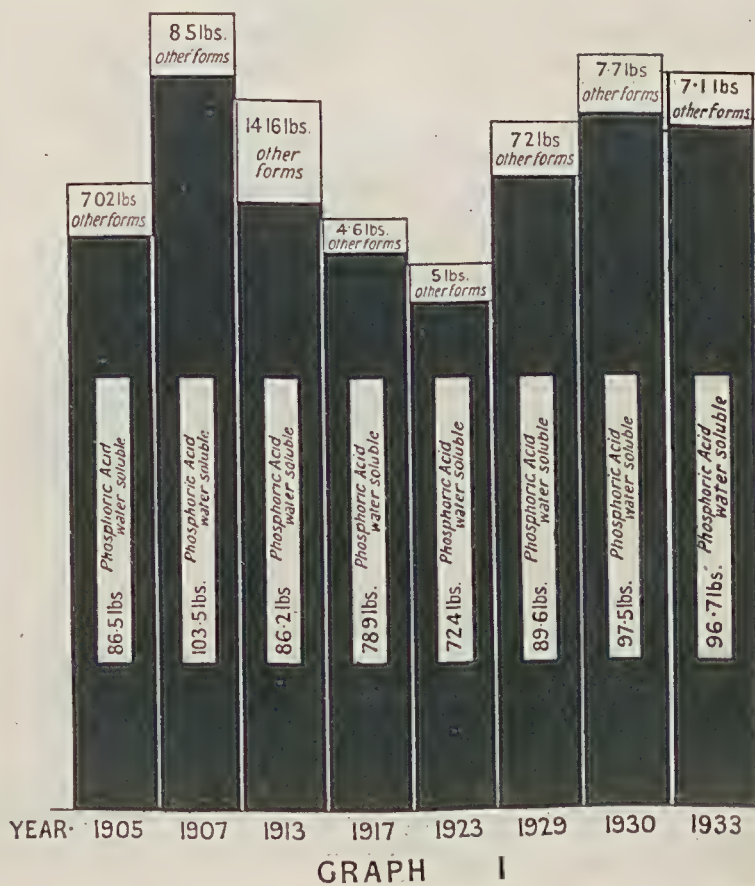
THE Fertilizers Act, which is administered by the Victorian Department of Agriculture, aims at assisting the producer by controlling the quality of the artificial fertilizers sold within the State.

The Act requires that, before any artificial fertilizer is offered for sale in Victoria, it must be registered at the office of the Director of Agriculture. Any person who sells an unregistered fertilizer is liable to a penalty of not less than £10 for a first offence, and of not less than £100 for any subsequent offence. No brand is registered unless the fertilizer it represents is of at least fair quality and commercial value; the farmer, therefore, should refuse to purchase any fertilizer unless some brand is affixed to it. Further, it is compulsory for the seller to see that every bag or parcel containing fertilizer exceeding 56 lb. in net weight bears a label setting out (a) the net weight in pounds; (b) the registered brand; (c) the name and address of the manufacturer or importer and the place of manufacture; (d) a chemical analysis guaranteeing the percentage of the three plant foods, viz.:—Nitrogen, phosphoric acid, and potash, and the respective forms in which each occurs in the fertilizer.

Invoice Certificate.

Upon the sale of any fertilizer, whether paid for at the time of sale or not, the vendor must, at the time of sale or before delivery of the

fertilizer, or any part thereof, give to the purchaser an invoice certificate signed by the vendor or his agent stating (a) the name and place of business of the vendor; (b) the registered brand; (c) the quantity of the fertilizer comprised in the sale; and (d) a chemical analysis guaranteeing the quality of the fertilizer in a similar manner to that on the labels attached



Showing the number of pounds of phosphoric acid received for every 20s. expended on superphosphate during the period 1905-1933.

to each bag or parcel. Infringement of the requirements of the Act regarding labelling or the giving of invoice certificates renders the vendor liable to a penalty.

It is important that farmers should see that an invoice certificate (which is a guarantee as to quality) is received with each parcel of fertilizer purchased and, furthermore, the certificate should be carefully preserved until the following season.

Unit Values.

The Chemist of the Department of Agriculture, from the results of the analyses of the simple fertilizers set forth in the application for the registration of brands, computes unit values annually.

The unit value as so calculated is the commercial value of 1 per cent. of nitrogen, phosphoric acid, or potash in their respective forms in 1 ton of fertilizer. Unit values provide the farmer with a useful method of ascertaining the comparative values of various fertilizers or of various brands of one particular fertilizer.

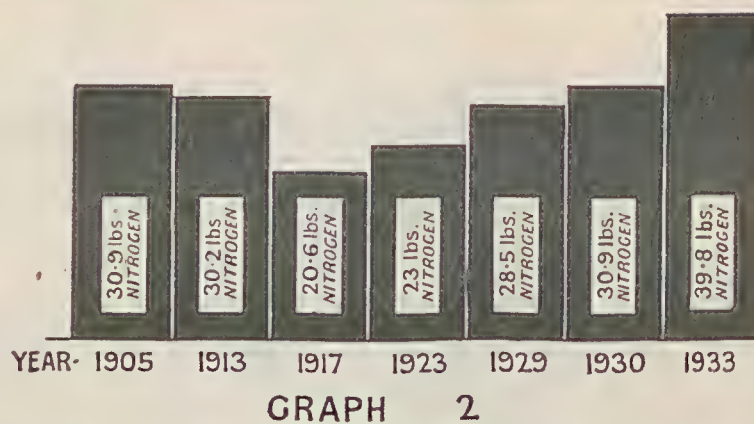
It should be remembered that "unit values" are the commercial values based on average ruling prices for simple fertilizers, and are not agricultural values fixed by the Department of Agriculture. The composition and retail price of a fertilizer (within reasonable limits) are in the hands of the manufacturers and importers; it will thus be readily seen that it is they who actually control unit values.

To compare the values of any artificial fertilizers on the market, the buyer must have—

- the list of unit values for the year;
- the percentage composition of the fertilizers.

The unit values for each year are printed in this *Journal* for the month of January, which contains also a list of the registered brands of the various fertilizers on the market, with the percentage composition or analysis of each.

Should the brand of any fertilizer, which has been sold or offered for sale, not appear in the



Showing the number of pounds of nitrogen received for every 20s. expended on sulphate of ammonia during the period 1905-1933.

list, the purchaser should communicate with the Chemist of the Department of Agriculture.

The comparative value of any given fertilizer per ton may be obtained by multiplying the percentage of each fertilizing ingredient by its respective unit value. The following examples will serve to illustrate:—

SULPHATE OF AMMONIA.

	Per Cent.	Unit Value.	s.	d.	£	s.	d.
Nitrogen as ammonia	20.59	$\times 11$	3	=	11	11	8
Calculated value per ton	..	..	..	=	11	11	8
Price asked per ton	..	..	..	=	11	2	9

As this calculation is based upon the approximate composition of the fertilizer, the farmer or producer who buys the fertilizer at the retail price per ton—viz., £11 2s. 9d.—is paying only a reasonable price.

BLOOD AND BONE.

	Per Cent.	Unit Value.	s.	d.	£	s.	d.
Nitrogen as Blood and Bone	6.64	$\times 18$	6	=	6	2	10
Phosphoric Acid as Citrate Soluble	8.62	$\times 4$	6	=	1	18	9
Phosphoric Acid as Citrate Insoluble	2.88	$\times 4$	0	=	0	11	6
Calculated value per ton	..	..	..	=	8	13	1
Price asked per ton	..	..	..	=	8	0	0

The above calculation indicates that this particular brand of Blood and Bone is really worth more per ton than the manufacturer is asking for

it. A similar calculation on the various brands of Blood and Bone fertilizer registered will prove useful in deciding which brand of the fertilizer should be purchased, due allowance being made for any difference in freight charges.

COMPLETE FERTILIZER.

	Per Cent.	Unit Value.			
		s. d.	£	s. d.	
Nitrogen as ammonia ..	1.00 × 11	3 =	0	11	3
Nitrogen as Blood, Bone, and Flesh ..	1.40 × 18	6 =	1	5	10
Phosphoric Acid as Water Soluble ..	10.94 × 4	6 =	2	9	3
Phosphoric Acid as Citrate Soluble ..	2.22 × 4	6 =	0	10	0
Phosphoric Acid as Citrate Insoluble ..	3.86 × 4	6 =	0	15	6
Potash as Chloride ..	5.00 × 7	0 =	1	15	0

Calculated value per ton 7 6 10
Price asked per ton 9 0 0

At first glance it would appear from the figures that too much is being charged for this fertilizer. It must be borne in mind, however, that in the case of mixed fertilizers consisting of a blend of several fertilizers, the cost of thoroughly incorporating the Potash, Nitrogen and Phosphate compounds to produce a homogenous mixture must be taken into consideration.

BONEDUST.

It will be noted that the list of unit values provides separate values for nitrogen and phosphoric acid as fine and coarse bone respectively. The Fertilizer Act requires that the mechanical condition of a bonedust shall be guaranteed, together with the percentages of nitrogen and phosphoric acid; in addition, bonedust is defined as a fertilizer consisting only of disintegrated bones, and containing at least 19 per cent. of phosphoric acid. The fine material must comprise at least 50 per cent. of the whole. The reason for this last stipulation is that the finer the degree of division of the bonedust the greater the availability of the nitrogen and phosphoric acid it contains.

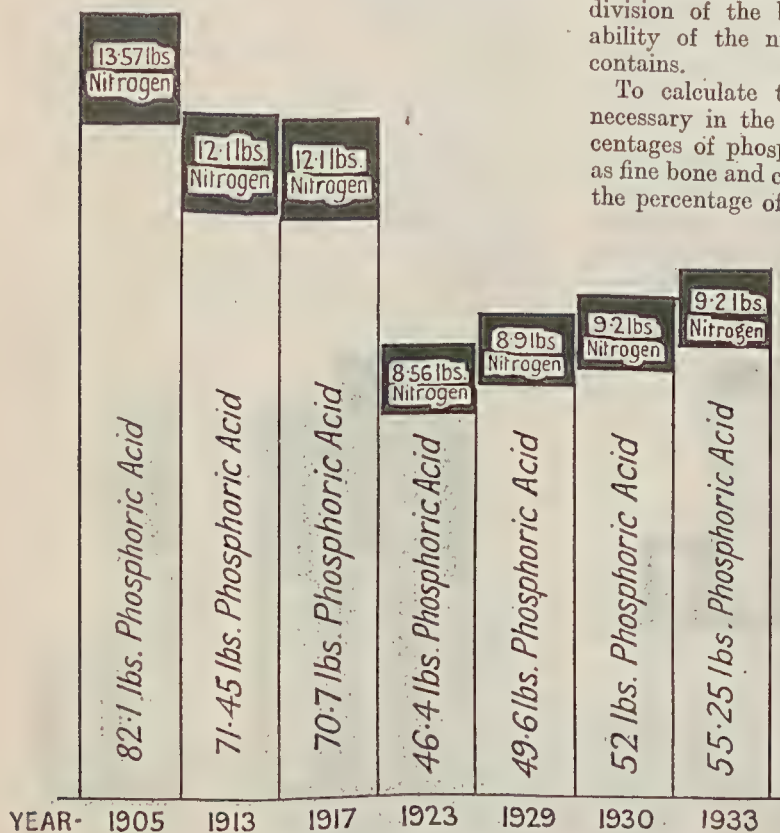
To calculate the value of a bonedust, it is necessary in the first place to compute the percentages of phosphoric acid and nitrogen present as fine bone and coarse bone. To do this, multiply the percentage of the fertilizing ingredient by the percentage of fine bone and divide by 100. This calculation will give the percentage as fine bone, which, when subtracted from the total, will leave the percentage as coarse bone.

Take the case of a bonedust guaranteed to contain:—

	Per cent.
Nitrogen ..	2.00
Phosphoric acid ..	24.00
Fine bone ..	70.00
Coarse bone ..	30.00

Then 2 per cent. of nitrogen × 70 (the percentage of fine bone) divided by 100 equals 1.40 per cent. nitrogen as fine bone, and this subtracted from the total nitrogen, viz., 2 per cent., leaves .60 per cent. nitrogen as coarse bone.

Similarly 24.00 per cent. of phosphoric acid × 70 (the percentage of fine bone) divided by 100 equals 16.80 per cent. of phosphoric acid as fine bone, and this figure subtracted from



GRAPH 3

Showing the number of pounds of nitrogen and phosphoric acid received for every 20s. expended on bonedust during the period 1905-1933.

the total phosphoric acid, viz., 24 per cent., leaves 7.20 per cent. of phosphoric acid as coarse bone.

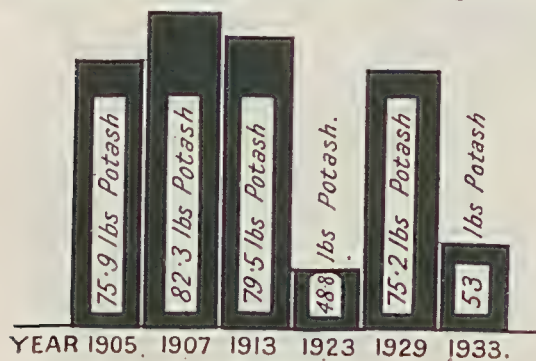
The calculated commercial value of this Bonedust is :—

	Per Cent.	Unit Value.	£	s.	d.
Nitrogen as fine bone	= 1.40	× 18 6	= 1	5	11
Nitrogen as coarse bone	= .60	× 16 6	= 0	9	11
Phosphoric Acid as fine bone	..	..	..	..	..
..	= 16.80	× 5 8	= 4	15	3
Phosphoric Acid as coarse bone	..	..	..	..	..
..	= 7.20	× 4 8	= 1	13	8
Calculated value per ton	..	..	8	4	9
Price asked per ton	..	..	10	0	0

In cases of this description it would be as well to calculate other brands which are on the market before deciding to purchase, unless it be that a low-nitrogen high-phosphoric acid ratio is the objective. There are instances known where horticulturists favour this type of animal fertilizer because of the nitrogen-phosphoric acid ratio.

PRICE ASKED PER TON.

It should be borne in mind when purchasing fertilizers that the price asked per ton is free on rails at the railway station nearest to place of manufacture, and in computing values of fertilizers it is essential that due allowance should be made for any freight charges that may be involved. For example, a farmer at Bairnsdale requiring a parcel of Bonedust would be foolish to pay say £7 per ton for a brand manufactured and sold f.o.r. at Hamilton when a bonedust of equal quality is obtainable at Sale at the same price.



GRAPH 4

Showing number of pounds of potash received for every 20s. expended on sulphate of potash during the period 1905-1933.

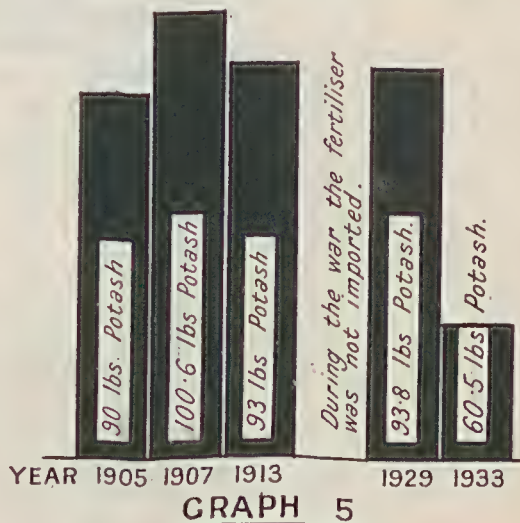
From the accompanying table it will be seen that while the unit value (i.e., the price) of our most important fertilizer, superphosphate, remains constant, the tendency is to increase the price of tankage fertilizers such as blood and bone and bonedust. As the heavy fall in the price of the

latter fertilizers during recent years has resulted in such a sustained demand as not only to deplete stocks but also to create an actual shortage, it follows that the price for these manures must harden and the unit values advance correspondingly.

UNIT VALUES FOR THE PAST AND PRESENT SEASONS COMPARED.

Form of Fertilizing Constituent.	Unit Value.		Per Cent.	
	1932.	1933.	Increase approximately.	Decrease approximately.
Nitrogen (Organic)—	s. d.	s. d.		
As Blood, Fine				
Bone, &c. ..	18 4	18 6	1	..
As Nitrate ..	21 6	21 3	..	1
As Coarse Bone, &c.	16 4	16 6	1	..
As Ammonia ..	11 8	11 3	..	3½
Phosphoric Acid—				
As Water Soluble ..	4 6	4 6	..	..
As Citrate Soluble in Blood and Bone, &c. ..	4 6	4 6	..	..
In Fine Bone ..	5 6	5 8	3	..
As Citrate Insoluble—				
In Blood and Bone, &c. ..	4 0	4 0	..	..
In Coarse Bone	4 6	4 8	4	..
In Ground Phosphate ..	2 6	2 4	..	7
Potash—				
As Sulphate ..	7 11	8 6	7	..
As Chloride ..	6 8	7 0	5	..

* 48.5% † 43.0%.



GRAPH 5

Showing the number of pounds of potash received for every 20s. expended on chloride of potash during the period 1905-1933.

It is interesting to note a further increase of from 5 to 7 per cent. in the unit value for potash more particularly in view of the large increase (25 to 29 per cent.) which occurred during the 1931-32 season. As there are no known deposits of potash salts in Australia this class of fertilizer has to be imported, and consequently is subject to exchange and other charges of the moment which account for the large increase in the unit values during the past two years.

PRICES IN VICTORIA AND LONDON.

In the following table the prices of the various fertilizers in Victoria and London are compared:—

Fertilizer.	Average Price per ton in Victoria.	Price per ton in London.
	£ s. d.	£ s. d.
Nitrate of Soda ..	16 5 0	8 9 0
Sulphate of Ammonia ..	11 10 4	5 5 0
Muriate of Potash ..	18 10 0	9 14 6
Sulphate of Potash ..	20 10 0*	11 12 3†
Superphosphate ..	4 15 0	2 12 6
		(3 17 0)
Bonedust ..	8 5 0	6 5 0

In connexion with the prices of superphosphate it is necessary to point out that the quality of the local fertilizer is much higher (20.5 per cent. water soluble phosphoric acid) than the English (14 per cent. water soluble phosphoric acid). The price in brackets represents the approximate price per ton when calculated to the quality of the local product.

Compared with the 1932 season the price of sulphate of ammonia abroad shows a marked decline, whilst the prices of potash fertilizers have increased. English superphosphate during the same period has increased slightly in price, and

sodium nitrate on the London market remains practically stationary. Bonedust shows a decline of 5s. per ton, but latest advices indicate that this fertilizer is in short supply and a hardening in the price is anticipated.

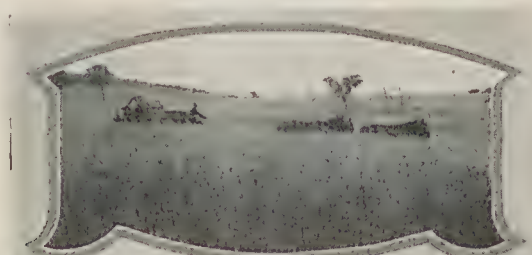
Graph I. shows the prices of superphosphate in Victoria during the past 28 years. It will be noted that "Super" is cheaper to-day than in 1913—the year immediately preceding the outbreak of the Great War. The high column of the year 1907, which means a low unit value for the phosphoric acid compounds existing in "Super," is directly attributable to the intense competition of the time.

Graph II. shows the decrease in the price of nitrogen as ammonium sulphate during the past two years. The fall in price, together with greater propaganda, has altered the position as regards this fertilizer remarkably. Years ago Victoria used to export approximately half of the sulphate of ammonia it manufactured. During the past season a quantity of the fertilizer had to be imported from England to meet the demand, and no sulphate of ammonia was exported.

Graph III. illustrates the fact that during the past two or three years the price of bonedust has eased, but it will be seen that there is room for a further decrease in price if the farmer is to receive bonedust at a price equalling that which existed during the years 1905-17.

Graph IV. shows that the price of sulphate of potash has increased recently until the price for the current season approaches that for the year 1923 when the effect of the war on this type of fertilizer had not been overcome. During the war, and for a year or two afterwards, potash fertilizers were not imported into Victoria.

Graph V., which deals with potash in the form of chloride or muriate, reveals a similar state of affairs.



Fertilizers Act 1928 (No. 3680).

LIST OF UNIT VALUES FOR THE YEAR 1933.

	£	s.	d.
Nitrogen, as Nitrate	1	1	3
„ organic, as Blood; Blood and Bone; Blood, Bone, and Flesh; and Fine Bone	0	18	6
„ „ as Coarse Bone and in Bone Fertilizers	0	16	6
„ as Ammonia	0	11	3
Phosphoric Acid—			
as Water Soluble	0	4	6
as Citrate Soluble—			
in Blood and Bone, in Animal Fertilizers, and in Mixed and Complete Fertilizers containing either or both of the foregoing	0	4	6
in all other Fertilizers	0	4	0
as Citrate Insoluble—			
in Blood and Bone, in Animal Fertilizers, and in Mixed and Complete Fertilizers containing either or both of the foregoing	0	4	0
in other Mixed Fertilizers and in Ground Phosphate	0	2	4
in other Fertilizers	0	1	0
as Fine Bone	0	5	8
as Coarse Bone	0	4	8
Potash, as Sulphate	0	8	6
„ as Chloride (muriate)	0	7	0

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1933.

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
<i>Nitrogenous—</i> <i>Readily Soluble.</i> Nitrate of Soda	Pivot	15.50	%	%	%	%	15.50	%	%	%	%	%	£ s. d. 14 15 0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
„ „	Sickle in diamond	15.50	..	..	..	..	15.50	..	..	..	..	..	17 0 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
„ „	Cresco	15.00	..	..	..	..	15.00	..	..	..	..	..	17 10 0	Cresco Fertilizers Ltd., Geelong
Nitrate of Lime and Ammonia	B.A. over S.F.	15.00	.50	..	..	..	15.50	..	..	..	..	..	14 10 0	Henry H. York and Co., Pty. Ltd., 573 Lonsdale-st., Melb.
Nitrate of Ammonia with chalk	Calnitro I.G., B.A. over S.F.	10.25	10.25	..	..	..	20.50	..	..	..	..	..	10 0 0	„ „ „ „
Sulphate of Ammonia	Sickle in diamond	..	20.60	..	..	..	20.60	..	..	..	..	..	12 2 6	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
„ „	Cresco	..	20.00	..	..	..	20.00	..	..	..	..	..	11 8 6	Cresco Fertilizers Ltd., Geelong
„ „	M.G. Co. in diamond	..	20.59	..	..	..	20.59	..	..	..	..	..	11 2 9	The Metropolitan Gas Co., Flinders-st., Melb.
„ „	Pivot	..	20.60	..	..	..	20.60	..	..	..	..	..	11 7 6	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
<i>Moderately Soluble.</i> Dried Blood	Imperial	..	..	12.00	..	..	12.00	..	..	.75	.75	.50	10 10 0	W. Angliss and Co. (Aust.) Pty. Ltd., 42 Bourke-st., Melb.
„ „	Pannifex	..	..	11.00	..	..	11.00	..	..	.50	.50	1.10	11 0 0	H. C. Pannifex and Co., 149-153 Stanley-st., West Melb.
„ „	M.C.C. Special in diamond	..	..	10.00	..	..	10.00	..	..	1.25	1.25	.61	9 10 0	Melbourne City Abattoirs, Smithfield-rd., Flemington
„ „	Brooklyn T.B. and S. in diamond	..	..	11.60	..	..	11.60	..	..	..	..	..	9 10 0	Thomas Borthwick and Sons (A/asia.) Ltd., 84 William-st., Melb.

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3880) FOR THE YEAR 1933—continued.

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
		%	%	%	%	%	%	%	%	%	%			
Blood Manure ..	Cockbill's ..	..	..	8.50	..	..	8.50	..	..	1.00	1.00	..	8 10 0	J. Cockbill, 407 Post Office-place, Melb.
" " "	Nifex ..	..	..	7.50	..	..	7.50	..	..	1.00	1.00	..25	7 15 0	H. C. Pannifex and Co., 149-153 Stanley-st., West Melb.
" " "	M.C.C. in diamond	..	..	8.02	..	..	8.02	..	..	1.25	1.25	..61	7 15 0	Melbourne City Abattoirs, Smithfield-rd., Flemington
" " "	Sickle in diamond	..	..	7.50	..	..	7.50	..	..	..	..	..	8 10 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
Slowly Soluble. Castor Meal ..	Alba ..	..	..	..	..	..	5.00 (as castor meal)	..	..	2.25	2.25	..75	5 15 0	Lycett Proprietary Ltd., Normanby-rd., Montague
Phosphatic— Readily Soluble. Superphosphate 22 per cent.	Lamaco ..	..	..	..	..	..	..	20.50	.50	1.00	22.00	..	4 15 0	New Zealand Loan and Mercantile Agency Co., 538 Collins-st., Melb.
" "	Cresco ..	..	..	..	..	..	..	20.50	.50	1.00	22.00	..	4 15 0	Cresco Fertilizers Ltd., Geelong
" "	Cockbill's ..	..	..	..	..	..	..	20.50	.50	1.00	22.00	..	4 15 0	J. Cockbill, 407 Post Office-place, Melb.
" "	Sickle in diamond	..	..	..	..	..	..	20.50	.50	1.00	22.00	..	4 15 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
" "	Pivot ..	..	..	..	..	..	..	20.50	.50	1.00	22.00	..	4 15 0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
Moderately Soluble. Super. and Rock Phosphate	Cresco 50/50 ..	..	..	..	..	..	..	9.16	1.84	17.40	28.40	..	5 0 0	Cresco Fertilizers Ltd., Geelong
" "	Sickle in diamond	..	..	..	..	..	..	10.00	.50	18.50	29.00	..	5 0 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
" "	Pivot ..	..	..	..	..	..	..	10.00	.50	18.50	29.00	..	4 15 0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
Basic Phosphate	Sickle in diamond	..	..	..	..	..	..	..	15.50	3.20	18.70	..	5 5 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
" "	Pivot ..	..	..	..	..	..	..	..	15.50	3.00	18.50	..	5 0 0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
Slowly Soluble. Ground Phosphate	Sickle in diamond (80%)	..	..	..	..	..	..	..	..	36.65	36.65	..	4 5 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
" "	Pivot ..	..	..	..	..	..	..	..	..	36.50	36.50	..	4 0 0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
" "	Pivot, very fine	..	..	..	..	..	..	..	..	36.50	36.50	..	4 10 0	" " " "
Potassic— Readily Soluble. Muriate of Potash	Sickle in diamond	..	..	..	..	..	..	..	..	..	..	50.00 (as chloride)	17 10 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
" "	Cresco ..	..	..	..	..	..	..	..	..	..	..	50.00 (as chloride)	19 10 0	Cresco Fertilizers Ltd., Geelong
" "	Cresco 30% Potash Manure Salt	..	..	..	..	..	..	..	..	..	..	30.00 (as chloride)	8 10 0	" " " "

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE
FERTILIZERS ACT 1923 (No. 3689) FOR THE YEAR 1933—continued.

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Sulphate of Potash	Cresco	..	..	..	..	..	..	..	..	..	..	48.50	20 10 0	Cresco Fertilizers Ltd., Geelong
"	Sickle in diamond	..	..	..	..	..	..	..	..	..	..	48.50	20 10 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
"	Pivot	..	..	..	..	..	..	..	..	..	..	48.50	20 10 0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
Containing Nitrogen and Potash— Readily Soluble. Super. and Ammonia	Pivot I.	..	2.90	..	..	..	2.90	17.40	.40	.80	18.60	..	6 2 6	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
"	Pivot II.	..	5.00	..	..	..	5.00	15.30	.30	.80	16.40	..	6 17 6	" " " "
"	Pivot II. (a)	..	6.80	..	..	..	6.80	13.60	.30	.60	14.50	..	7 7 6	" " " "
"	Pivot III.	..	10.00	..	..	..	10.00	10.20	.20	.50	10.90	..	8 10 0	" " " "
"	Sickle in diamond (6 to 1)	..	2.94	..	..	..	2.94	17.57	.43	.85	18.85	..	6 7 6	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
"	Sickle in diamond (3 to 1)	..	5.15	..	..	..	5.15	15.37	.37	.76	16.50	..	7 2 6	" " " "
"	Sickle in diamond (2 to 1)	..	6.87	..	..	..	6.87	13.66	.34	.66	14.66	..	7 17 6	" " " "
"	Sickle in diamond (1 to 1)	..	10.30	..	..	..	10.30	10.25	.25	.50	11.00	..	9 0 0	" " " "
"	Cresco (6 to 1)	..	2.85	..	..	..	2.85	17.48	.42	.85	18.75	..	6 7 6	Cresco Fertilizers Ltd., Geelong
"	Cresco (3 to 1)	..	5.00	..	..	..	5.00	15.37	..	1.13	16.50	..	7 2 6	" " " "
"	Cresco (2 to 1)	..	6.87	..	..	..	6.87	13.66	.34	.66	14.66	..	7 17 6	" " " "
Nitro - Super-phosphate	Cresco	..	1.50	..	.50	..	2.00	16.39	1.10	1.70	19.19	..	6 15 0	" " " "
"	Sickle in diamond	..	1.50	..	.50	..	2.00	16.69	1.12	2.01	19.82	..	6 15 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
Moderately Soluble.														
Ammonia and Rock Phosphate	Cresco	..	2.00	..	..	..	2.00	8.30	1.60	15.70	25.60	..	6.5 0 0	Cresco Fertilizers Ltd., Geelong
Blood, Bone, and Super.	Cockbill's	..	..	..	2.50	..	2.50	12.51	1.43	2.96	16.90	..	7 10 0	J. Cockbill, 407 Post Office-place, Melb.
"	Sickle in diamond	..	..	..	2.50	..	2.50	12.51	1.43	2.96	16.90	..	7 10 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
Bone and Super.	Sickle in diamond, No. 1	..	..	..	2.00	..	2.00	11.38	3.08	5.32	19.78	..	6 17 6	" " " "
"	J. A. Dundas	..	..	..	2.25	..	2.25	9.99	5.16	5.58	20.73	..	8 0 0	J. A. Dundas, Dynon-rd., Footscray
"	Cresco	..	..	..	..	..	2.00	9.50	3.90	3.00	16.40	..	6 17 6	Cresco Fertilizers Ltd., Geelong
Bone Fertilizer and Super	Rohs in circle..	..	..	..	..	..	1.50	9.50	2.00	4.50	16.00	..	7 10 0	P. Rohs Pty. Ltd., Bridge-st., Bendigo
"	Elsworth's	..	..	..	..	..	1.50	11.00	2.50	5.00	18.50	..	6 17 6	W. R. Elsworth, York-st., Ballarat
"	King's, Geelong	..	..	..	1.60	..	1.60	6.15	5.50	3.85	15.50	..	6 15 0	J. C. King and Sons Pty. Ltd., Marshall
Super. and Bone	Sickle in diamond, No. 2	..	..	..	1.00	..	1.00	15.95	1.79	3.16	20.90	..	6 0 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
"	Cresco	..	..	..	1.00	..	1.00	16.10	1.10	3.60	20.80	..	6 0 0	Cresco Fertilizers Ltd., Geelong
Blood and Bone	W. & M. in circle	..	..	..	6.00	..	6.00	..	4.50	5.50	10.00	..	6 15 0	Western and Murray Co-operative Bacon and Meat Packing Co. Ltd., 522 Flinders-lane, Melb.
"	Fitzgerald's	..	..	..	5.10	..	5.10	..	9.75	4.40	14.15	..	7 10 0	P. Fitzgerald and Sons, Warrigal-rd., Oakleigh

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1933—continued.

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
		%	%	%	%	%	%	%	%	%	%			
Blood and Bone	Dundas' ..	..	..	..	..	4.50	4.50	..	7.14	13.61	20.75	..	8 0 0	J. A. Dundas, Dynon-rd., Footscray
" "	Imperial ..	..	..	..	..	5.00	5.00	..	5.00	11.00	16.00	..	7 0 0	W. Angliss and Co. (Aust.) Pty. Ltd., 42 Bourke-st., Melb.
" "	W.A. & Co. in diamond	..	..	..	..	6.00	6.00	..	3.00	7.00	10.00	..	7 10 0	" " " "
" "	Corio ..	..	..	..	..	4.00	4.00	..	6.00	8.00	14.00	..	6 15 0	The Corio Trading Co. Pty. Ltd., 164 Moorabool-st., Geelong
" "	T.B. & S. in diamond—Brooklyn	..	..	..	..	6.00	6.00	..	9.00	4.00	13.00	..	7 10 0	Thomas Borthwick and Sons (A/asia) Ltd., 84 William-st., Melb.
" "	T.B. & S. in diamond—Lighthouse	..	..	..	..	6.00	6.00	..	5.00	2.00	7.00	..	7 10 0	" " " "
" "	Cockbill's ..	..	..	..	..	5.25	5.25	..	3.00	9.00	12.00	..	8 10 0	J. Cockbill, 407 Post Office-place, Melb.
" "	Cresco ..	..	..	..	..	5.00	5.00	..	3.00	11.50	14.50	..	8 0 0	Cresco Fertilizers Ltd., Geelong
" "	Arch No. 1 ..	..	..	..	..	6.64	6.64	..	8.62	2.88	11.50	..	8 0 0	Amalgamated Freezing Co. (Vict.) Pty. Ltd., 54 Market-st., Melb.
" "	Arch No. 2 ..	..	..	..	..	8.14	8.14	..	3.83	2.99	6.82	..	8 0 0	" " " "
" "	Arch No. 3 ..	..	..	..	..	7.56	7.56	..	6.54	2.12	8.66	..	8 0 0	" " " "
" "	Oak Brand ..	..	..	..	..	6.90	6.90	..	4.00	5.50	9.50	..	8 10 0	H. C. Pannifex and Co., 149-153 Stanley-st., West Melb.
" "	Pannifex No. 1 ..	..	..	..	..	6.35	6.35	..	5.00	6.50	11.50	..	8 15 0	" " " "
" "	Pannifex No. 2 ..	..	..	..	..	7.17	7.17	..	5.00	6.99	11.99	..	9 0 0	" " " "
" "	Pannifex No. 5 ..	..	..	..	..	8.00	8.00	..	3.00	5.00	8.00	..	8 10 0	" " " "
" "	Sickle in diamond	..	..	..	..	5.00	5.00	..	6.00	10.00	16.00	..	8 0 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
" "	Pridham's ..	..	..	..	..	5.00	5.00	..	8.00	6.00	14.00	..	7 10 0	W. Pridham, Pty. Ltd., Evans-st., Braybrook
" "	Apollo ..	..	..	..	..	5.00	5.00	..	4.00	12.00	16.00	..	8 0 0	J. Kitchen and Sons Pty. Ltd., Ingles-st., Port Melb.
" "	C.K. Rohs in circle ..	..	..	..	..	4.65	4.65	..	7.06	7.44	14.50	..	7 10 0	Joseph Reid, Elliminyt P. Rohs Pty. Ltd., Bridge-st., Bendigo
" "	King's, Geelong ..	..	..	..	..	4.00	4.00	..	6.00	8.00	14.00	..	8 5 0	Joseph C. King and Sons Pty. Ltd., Marshall
Animal Fertilizer	Fertbone ..	..	..	..	..	5.00	5.00	..	4.00	8.00	12.00	..	7 10 0	H. C. Pannifex and Co., 149-153 Stanley-st., West Melb.
" "	Pannifex's No. 2 ..	..	..	..	..	4.50	4.50	..	5.00	12.00	17.00	..	7 15 0	" " " "
" "	Pannifex's No. 3 ..	..	..	..	..	5.50	5.50	..	5.00	10.00	15.00	..	8 0 0	" " " "
" "	Pannifex's No. 4 ..	..	..	..	..	6.00	6.00	..	5.00	7.00	12.00	..	8 15 0	" " " "
" "	Pannifex's No. 5 ..	..	..	..	..	3.00	3.00	..	5.00	12.00	17.00	..	7 0 0	" " " "
" "	Fitzgerald's ..	..	..	..	..	3.50	3.50	..	10.25	7.75	18.00	..	7 10 0	P. Fitzgerald and Sons, Warrigal-rd., Oakleigh
" "	A.N.A. Surprise ..	..	..	..	..	5.00	5.00	..	4.00	10.00	14.00	..	7 10 0	G. W. Pennell, Burke-st., Braybrook
Bone Fertilizer	Elsworth's ..	..	..	..	..	..	4.00 (as bone)	..	5.80	11.70	18.00	..	7 10 0	W. R. Elsworth, York-st., Ballarat
Mixed Manure ..	Humo-Phos. ..	..	1.28	1.03 (as organic)	..	..	2.31	..	..	5.46	5.46	..	4 5 0	Peninsula Lime and Fertilizer Co. Pty. Ltd., 70 Elizabeth-st., Melb.
Containing Nitrogen, Phosphoric Acid and Potash.	Cresco ..	..	1.50	..	1.56	..	3.06	11.65	1.49	3.26	16.40	2.42	8 10 0	Cresco Fertilizers Ltd., Geelong
Market Garden Manure	Sickle in diamond	..	1.72	..	..	1.56	3.28	10.26	2.43	4.23	16.92	2.42	8 10 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE
FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1933—continued.

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Complete Manure	Sickle in diamond, No. 1	..	1.00	..	..	1.40	2.40	10.94	2.22	3.86	17.02	5.00 (as chloride)	9 0 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melb.
"	"	..	1.00	1.00	..	..	2.00	14.85	.36	.72	15.93	4.85	8 10 0	" " " "
"	Sickle in diamond, No. 2	..	2.57	..	..	..	2.57	15.37	.38	.75	16.50	6.06	8 0 0	" " " "
"	Sickle in diamond (A)	..	5.15	..	..	..	5.15	12.81	.31	.63	13.75	6.06	9 2 6	" " " "
"	Sickle in diamond (B)	..	0.15	..	..	..	9.15	9.11	.22	.44	9.77	5.39	10 5 0	" " " "
"	Sickle in diamond (C)	..	8.24	..	..	..	8.24	8.20	.20	.40	8.80	10.00 (as chloride)	11 2 6	" " " "
"	Pivot IV.	..	2.90	..	..	..	2.90	14.30	.30	.70	15.30	6.90	8 7 6	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
"	Pivot V.	..	8.20	..	..	..	8.20	8.20	.20	.40	8.80	9.60	11 0 0	" " " "
"	Pivot VI.	..	9.10	..	..	..	9.10	9.10	.20	.40	9.70	5.30	9 17 6	" " " "
Mixed Manure	Cresco No. 2	..	1.00	..	1.40	..	2.40	11.25	2.00	4.50	17.75	5.00	9 5 0	Cresco Fertilizers Ltd., Geelong
"	Cresco No. 3	..	9.15	..	..	..	9.15	9.11	.22	.44	9.77	5.39	10 5 0	" " " "
Nitrophoska	I.G. No. 3, BA over SF	4.50	11.50	..	..	..	16.00	15.50	..	..	15.50	21.50 (as chloride)	22 10 0	Henry York and Co. Pty. Ltd., 573 Lonsdale-st., Melb.

Description of Fertilizer.	Brand.	Nitrogen.	Phosphoric Acid.	Mechanical Condition.		Price asked per ton.*	Where obtainable.
				Fine Bone.	Coarse Bone.		
Bonedust	Mount Clear	3.00	19.00	50.00	50.00	7 0 0	Ballie Bros., Sturt-street, Ballarat
"	Ox	3.95	21.36	50.00	50.00	7 10 0	Thomas Brown Successors, Gray-street, Hamilton
"	Rohs in circle	4.00	19.00	50.00	50.00	8 0 0	P. Rohs Pty. Ltd., Bridge-street, Bendigo
"	Oak	2.00	24.00	70.00	30.00	10 0 0	H. C. Pannifex and Co., 149-153 Stanley-street, West Melbourne
"	Pannifex's No. 2	4.00	19.00	50.00	50.00	9 0 0	" " " "

* F.O.B. at station nearest place of manufacture or, when imported, Melbourne.

Standard Herd Records

In the Journal for December the amount of butter fat required for a certificate in the various classes was, owing to an oversight, given incorrectly.

The requirements are :—

Junior 2 year old (under 2½ years at time of calving)	..	230 lb. butter fat.
Senior 2 year old (between 2½ and 3 years at time of calving)	..	250 lb. butter fat.
Junior 3 year old (between 3 and 3½ years at time of calving)	..	270 lb. butter fat.
Senior 3 year old (between 3½ and 4 years at time of calving)	..	290 lb. butter fat.
Junior 4 year old (between 4 and 4½ years at time of calving)	..	310 lb. butter fat.
Senior 4 year old (between 4½ and 5 years at time of calving)	..	330 lb. butter fat.
Mature cow (5 years and over)	..	350 lb. butter fat.

Professional Papers

[This section is devoted to professional papers and articles of a scientific character.]

Studies of Growth and Fruit Bud Formation

No. III.—A Year's Observations on Victorian Plums (1) (2)

By C. Bernard, M.Sc., Botanist, Division of Plant Industry, C.S.I.R., and

Frank M. Read, M.Agr.Sc., Senior Horticultural Research Officer, Department of Agriculture, Victoria.

THE value and application of a knowledge of the development of the blossom buds of Victorian fruit trees has been indicated in previous articles (2 and 3) which dealt with the fruit buds of the apple and pear. The present communication continues this series, and contains data in respect to the blossom bud development of the plum and prune in Victoria.

The development of the bud of the plum and prune has not been investigated previously, so far as we are aware, in any locality in the Southern Hemisphere, though information has been obtained, and the time of differentiation of the blossom buds determined, in a number of localities in Europe and North America. Table I. summarizes these investigations:—

TABLE I.—DATES OF BLOSSOM BUD DIFFERENTIATION—PLUMS.

Variety.	Differentiation First Noted.	Locality.	Investigation.
Rollingstone (<i>Prunus Americana</i>)	{ 8th July, 1899 ..	Wisconsin ..	Goff (6)
	{ 5th July, 1900 ..	" ..	" (7)
Wittaker (<i>Pr. Munsoniana</i>)	1st Sept., 1909 ..	Virginia ..	Drinkard (5)
Japanese (<i>Pr. triflora</i> or <i>Pr. salicina</i>) ..	14th July, 1909 ..	" ..	"
	{ 31st July, 1915 ..	California ..	Trunk (12)
Wickson (hybrid <i>Pr. Simonii</i> and <i>Pr. triflora</i>)	{ Middle Aug., 1923 ..	England ..	Tufts and Morrow (13)
	{ 25th July, 1924 ..	" ..	Ball (1)
Victoria (<i>Pr. domestica</i>)	{ 13th July, 1926 ..	" ..	"
	{ 6th Aug., 1924 ..	" ..	"
Monarch (<i>Pr. domestica</i>)	{ 25th July, 1925 ..	" ..	"
	{ 6th Aug., 1924 ..	" ..	"
Pond's Seeding (<i>Pr. domestica</i>)	{ 13th July, 1925 ..	" ..	"
Drap d'or d'Esperen (<i>Pr. domestica</i>) ..	{ Beginning of July ..	Holland ..	Luyten (10)
Reine Claude Verte (<i>Pr. domestica</i>) ..	{ 29th June, 1920 ..	California ..	Hartwell (8)
French Prune (<i>Pr. domestica</i>)	{ Mid. Aug., 1923 ..	" ..	Tufts and Morrow (13)

(1) The first and second articles of the series dealing with observations on Victorian apples and pears appeared in the July and September issues of the *Journal* (2) (3).

(2) This work has been carried out by the Council for Scientific and Industrial Research and the Department of Agriculture, Victoria, in co-operation. The selection and sampling of material and the observations of tree behaviour have been made by the Victorian Department, whilst the C.S.I.R. has carried out the microscopical examination of the buds and the preparation of the photomicrographs.

(3) The numbers in brackets throughout the text refer to the works of reference cited at the conclusion of the paper.

An examination of these data shows that the time of differentiation varies with the species and variety as well as with the locality and season. The variation from season to season, which is illustrated by Ball's results (1) and which has been observed in the case of other fruits, is the most important. This factor considerably lessens the value of information obtained in respect to the time of differentiation in any one season, for the results of one season's observations are not necessarily strictly applicable in the following season. On the other hand, a knowledge of the factors responsible for such seasonal variations would constitute a valuable addition to our knowledge of the factors influencing fruit bud formation. This information can be obtained only by investigations extending over a number of seasons. One of the aims of the present inquiry, therefore, has been to discover whether the critical period of differentiation may be correlated with a definite stage in the vegetative growth of the

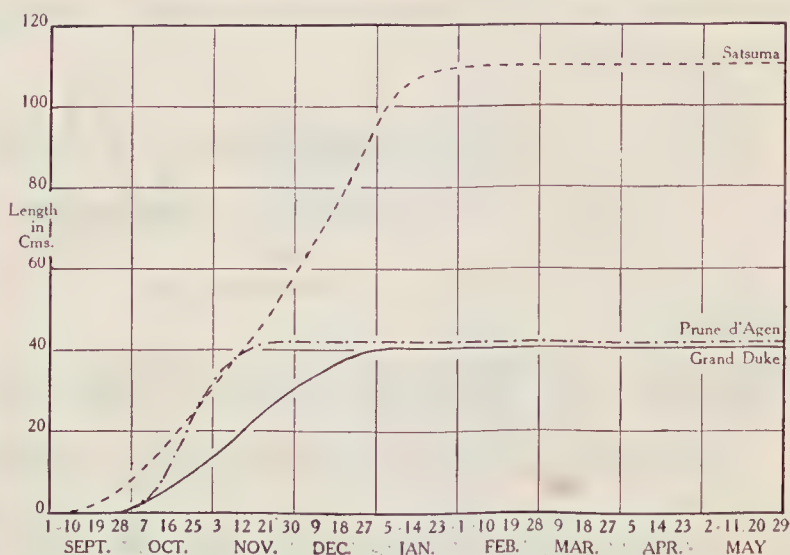


Fig. 1.—Showing the growth made by typical current season's shoots of Grand Duke and Satsuma plums at Templestowe, and Prune d'Agen at Shepparton, Victoria—season 1930-31.

shoots or spurs. Upon the establishment of such a correlation it would be possible to determine the critical period each season by means of comparatively straightforward field observations and measurements. The significance of a correlation between fruit bud formation and the type or quality of vegetative growth has been pointed out previously (2).

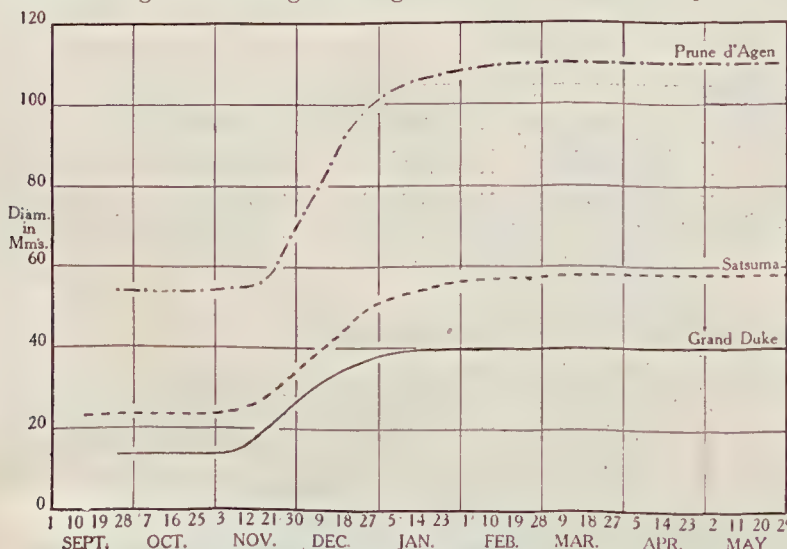


Fig. 2.—Showing the increase in diameter of typical two-years'-old wood of Grand Duke and Satsuma plums at Templestowe, and Prune d'Agen at Shepparton, 1930-31.

Source of Material and Technique.

The Grand Duke plum (*Prunus domestica*) and the Satsuma plum (*P. salicina*) have been studied at Templestowe, Victoria; while at Shepparton, in the more northerly irrigated Goulburn Valley area, the principal prune, Prune d'Agen (*P. domestica*), has been observed.

The technique employed in the growth measurements, the sampling of buds, and their subsequent microscopical examination was similar to that described for apples (2) and for pears (3).

In the Grand Duke, buds were taken from new spurs

on two years' old wood. In the Satsuma, buds from spurs at least four years old were sampled throughout the season. In addition, axillary triple buds on the current season's growth of Satsuma were collected for a short period to determine, as a matter of interest, the difference between their time of blossom initiation and that of the aged spurs on which, in this district, the crop is carried.

The Prune d'Agen trees at Shepparton were making such vigorous growth that very few of the short-spur growths, on which this variety normally bears most extensively, were to be seen. Under the circumstances it was decided to sample axillary buds on current season's wood.

Growth of Trees.

Throughout the year observations and measurements of a qualitative nature were made. Table II. has been compiled from the data so obtained, and briefly summarizes the progress of vegetative growth.

Figures 1 and 2 graphically represent respectively the increase in length of a typical lateral shoot of each variety; and the increase in diameter of the two years' old wood of the trees. It should be clearly understood that no quantitative estimate of growth is possible from the rather limited number of individual shoots studied. The figures are intended to show in a general way when growth in length and diameter increase were taking place, and in particular the dates of commencement and cessation.

Figure 1 shows that a comparatively very strong growth of lateral shoots was made by the Japanese plum Satsuma. This has probably been brought about to a great extent by the system of pruning adopted on this orchard. The main arms of the trees have spurred freely throughout their length, as is

usual with such plums, and the winter pruning consists of a complete removal of all lateral shoots. Shoots continued to elongate until the middle of February. This prolonged growth may be due to the hard pruning referred to; but general observations indicate that growth in the Japanese plums ceases considerably later than in the European sorts.

In the Grand Duke and Prune orchards studied, no such hard pruning was practised; the continual provision of new spurs on two years' old wood necessitating the cutting back or thinning out of only a portion of the new growth each year.

Length growth in the Prune ceased very early, before the end of November; but was rapid while in progress. Growth in the Grand Duke was somewhat slower, and ceased at the end of December except in the case of a few leading shoots which continued until the third week in January.

Diameter increase of two years' old wood did not commence (see Figures 1 and 2) in the Prune until length growth was practically finished for the year; while in Grand Duke and Satsuma the thickening of the older wood appears to have been most rapid during the latter half of the length-growth period. In all cases thickening continued until a short time before defoliation commenced.

Bud Development.

(a) Organization of the Flower Buds.

The flower buds of the Grand Duke plum (*Prunus domestica* var.), the Prune d'Agen (*P. domestica* var.), and the Satsuma plum (*P. salicina* var.) are very much alike in their structure and development. These fruits possess "simple" buds which are different in organization to the "mixed" buds described previously in the case of the apple (2) (*Pyrus malus*) and the pear (3) (*Pyrus communis*).

TABLE II.—DETAILS OF GROWTH OF PLUM TREES IN VICTORIA, SEASON 1930-31.

	Grand Duke Plum (<i>Prunus domestica</i> var.), Templestowe.	Satsuma Plum (<i>Prunus salicina</i> var.), Templestowe.	Prune d'Agen (<i>Prunus domestica</i> var.), Shepparton.
Full bloom	15th September ..	1st September ..	25th September
Leaf bud burst	20th September ..	8th September ..	28th September
Spur leaves fully grown	14th November ..	6th November ..	10th November
Thickening of two-year and older wood commences	15th November ..	15th November ..	1st November
Length growth of shoots ceases	1st January ..	14th February ..	24th November
Crop mature	10th February ..	6th February ..	23rd February
Thickening of two-year and older wood ceases ..	28th February ..	15th March ..	28th February
Defoliation commences	1st to 7th March ..	1st to 7th April ..	1st to 7th March
Defoliation complete	15th April ..	31st May ..	30th April

In the latter type of bud a cluster of foliage leaves is produced as well as an inflorescence of flowers. In the former, on the other hand, no foliage leaves are present and one or a few flowers are developed from an apparently terminal position on the axis.

In the Grand Duke plum, sixteen to eighteen bud scales are inserted in spiral sequence on the axis, and one to three flowers are produced; the usual number in each bud being two. The outer two or three scales are short, thickened at the base, and dark brown in colour. The succeeding nine or ten are thinner, and possess a membranous dentate margin. They are dark coloured above and of a lighter hue in the lower part. The inner four bud scales are quite different. They are tripartite, having three lobes which are homologous with the lamina and stipules of the foliage leaves, and they resemble the transition leaves described in the apple (2) and pear (3). Foliage leaves are occasionally produced in the flower bud of the plum, and this most frequently occurs when the bud is terminal. Such leaves, no doubt, arise from these foliage like cataphylls, which usually function as bud scales.

Finally, two or three small and inconspicuous bracts are developed from the growing point, and the flower primordia arise in the axils of these bracts. Growth ceases in the vegetative apex, and the developing flowers, as they increase in size, assume a terminal position.

In the bud of the Satsuma plum, from 25 to 28 leaf formations are developed. The outer 18 to 20 are definitely bud scales, and similar to those described for the Grand Duke. They are, however, only slightly denticulate. The inner seven or eight cataphylls are tripartite, and in this respect similar to the inner four bud scales of the Grand Duke. The normal number of flowers in each bud is three in the Satsuma, but quite frequently four are developed. In the Prune d'Agen, on the other hand, though two primordia are usually initiated, only one flower matures in each bud.

In other respects the development of the blossom buds of the three varieties is similar, and therefore the bud of the Grand Duke only is described in detail whilst comparative notes are given in respect to the Japanese variety and to the Prune.

(b) *Differentiation and Development of Flower Buds.*

The potential flower buds do not exhibit any features whereby they may be distinguished

from potential leaf buds during the early part of the season. In the Grand Duke Plum and the Prune, differentiation of the blossom buds begins at the end of December, and in the case of the Satsuma about one month later. The appearance of the bud, before differentiation takes place, is described in stage 1 below:—

Stage (I.) (Fig. 1, Pls. 1 and 2).—The growing point of the undifferentiated bud is small and conical, and bud scale initials are split off in rapid succession.

Stage (II.).—The growing point enlarges (Fig. 2, Pl. 1, and Fig. 2, Pl. 2), and prepares for flower formation. This elevation and enlargement of the growing point is the first manifestation of differentiation.

Stage (III.).—From the enlarged apex, several bracts are formed, and a flower primordium ("FP" Fig. 3, Pl. 1) arises in the axil of each bract. The flower primordia grow rapidly, becoming the rounded knob-like structures seen in Fig. 4, Pl. 1, and the vegetative apex (V) which has ceased growing is pushed to one side by their development. Finally the primordia flatten on top (Fig. 2, Pl. 2) preparatory to the formation of the flower parts. The same stage in the Satsuma Plum is illustrated in Fig. 5, Pl. 1. In the Prune d'Agen two flower primordia are usually initiated, but one, which is generally smaller than the other, is aborted almost immediately; rarely do both develop (Fig. 6, Pl. 1).

Stage (IV.).—The five sepals (K) arise from a ridge formed on the flattened top of the flower primordium.

Stage (V.).—The petal primordia (c) arise next as small knobs alternating with the sepals (Satsuma, Fig. 7, Pl. 1, Grand Duke, Fig. 8, Pl. 1).

Stage (VI.).—The stamens (Δ) arise as small papillae which are arranged in cyclic rings.

Stage (VII.) (Fig. 9, Pl. 1 to Fig. 3, Pl. 2).—The appearance of the flower at the time of the origin of the carpel (G) is shown in Fig. 9, Pl. 1. The carpel arises as a protuberance from the base of the receptacle, and rapidly becomes the dome-shaped structure shown in Fig. 3, Pl. 2. Subsequent development consists of the growth of the parts of the flower, and is illustrated in the photo-micrographs represented in Figs. 4 and 5, Pl. 2. In Fig. 4 the stamens are beginning to differentiate into anther and filament.

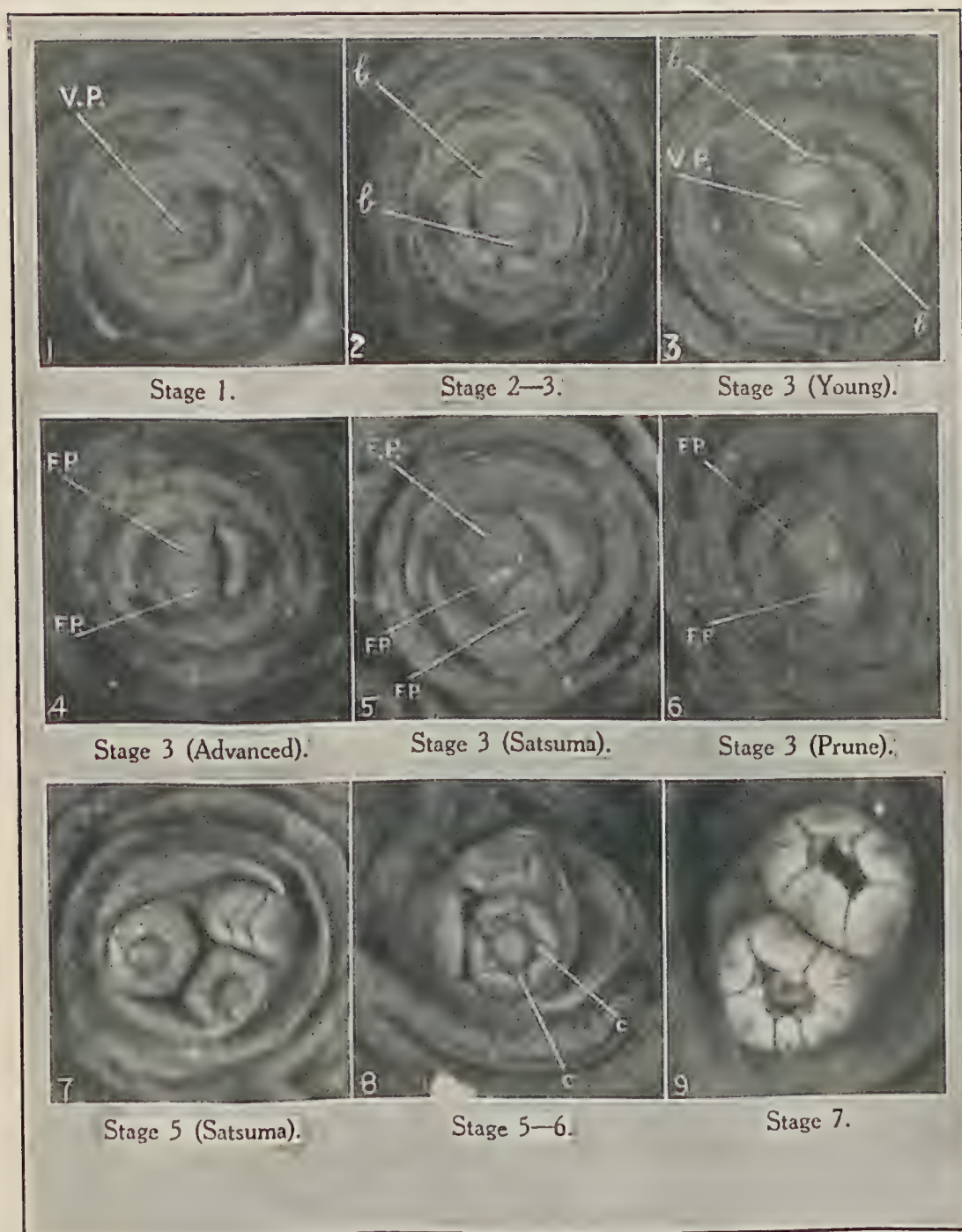


Plate 1.—Blossom bud development in the Grand Duke plum, Templestowe, Vic. Figs. 5 and 7, Satsuma plum, and Fig. 6, Prune d'Agen, Shepparton. (Magn. $\times 62$.)

[Key—V.P., growing point; b, Bracts; F.P., Flower primordium; K, Sepal (calyx); C, Petal (corolla); A, Stamen (androecium); G, Carpel (gynaecium); and ov., Ovule.]

Stage (VII).—The stage reached by the buds about the end of May is slightly less advanced than that illustrated in Figs. 5 (Grand Duke) and 7 (Satsuma) Pl. 2. Sporogenous tissue has differentiated in the anthers, and a well defined loculus is present in the ovary. The buds develop very slowly through June and July, and by the end of the latter month have reached the stages shown in the figures to which reference has just been made. Several ovules arise as small bulges on the inner edge of the carpel, though only one ("ov") is visible in Fig. 5.

Stage (IX).—The buds commence to develop very rapidly again sometime prior to the middle of August. In the Grand Duke spore mother cells were formed in the anthers, and the flowers had increased considerably in size (Fig. 6, Pl. 2) by 14th August.

Stage (X).—In the Satsuma Plum, development had either been more rapid or had commenced sooner because the stage reached by the middle of August (Fig. 8, Pl. 2) is very advanced, pollen grains and a well developed ovule having been formed. Table II. shows that this is reflected in the comparatively early blooming period of Satsuma. It is interesting to note that, though two or three ovules are formed only one reaches maturity, the others apparently being aborted during development.

In the Prune d'Agen growth was just recommencing by the middle of August, and the typical flower at this time had reached the stage illustrated in Fig. 9, Pl. 1.

In Table III. the time of the season during which the majority of buds were in the stages described above are set out for each variety.

Discussion.

In the three varieties of plum studied, just as in the pear (3), there appears to be a fairly consistent relation between the time of differentiation of blossom buds, and the cessation of length growth in the tree (compare Tables 2 and 3):

In the Grand Duke and Satsuma varieties spur buds have been taken. In each case, with the exception of a few forward buds, initiation of blossom occurs in the week following cessation of shoot growth.

Differentiation of spur buds in apples (2) seemed to be correlated with maturity of spur leaves; but in the plums no such relationship is evident. The growth of spur leaves in both Satsuma and Grand Duke is completed about mid-November, in fact Satsuma is a little earlier than this; but there is a difference of from four to five weeks in the dates on which

TABLE III*.—SHOWING THE DATES OF BLOSSOM BUD DIFFERENTIATION, AND THE DATES AT WHICH THE VARIOUS STAGES OF BUD DEVELOPMENT WERE REACHED. GRAND DUKE AND SATSUMA PLUMS AND PRUNE D'AGEN 1930-31.

Variety.	Stage 2. Differentiation.	Stage 3. Flower Primordia.	Stage 4. Sepals.	Stage 5. Petals.	Stage 6. Stamens.	Stage 7. Carpels.	Stage 8. Sporogenous Tissue in Anthers.	Stage 9. Ovules and Spore Mother Cell.	Stage 10. Pollen Grains.
Grand Duke, Templestowe, Vic. Spur Buds ..	1st week in Jan. 26.12.30	2nd and 3rd week in Jan. 9.1.31	4th week in Jan. 23.1.31	Beginning of Feb. 30.1.31	3rd week in Feb. 30.1.31	2nd week in March 20.2.31	May, June, July 1.5.31	Mid. Aug.	
Satsuma, Templestowe, Vic. Spur buds ..	2nd and 3rd week in Feb. 6.2.31	1st and 2nd week in March 20.2.31	3rd and 4th week in March 13.3.31	End of March 29.3.31	1st week in April 20.3.31	Mid April 10.4.31	May, June, July 1.5.31	..	Mid. Aug.
Satsuma, Templestowe, Vic. Axillary buds on current season's growth ..	Beginning of March ..	End of March 27.3.31	Mid. April 10.4.31	..	..	..	..	..	..
Prune d'Agen, Shepparton, Vic. Axillary buds on current season's growth ..	End of Dec. 22.12.31	End of Jan. 5.1.31	1st week in Feb. 16.1.31	Mid. Feb. 16.2.31	..	Early in May	Mid. Aug.	..	..

* The time during which the majority of buds are in the stage shown is indicated by reference to the month. The actual dates refer to the time at which the most advanced bud reached the stage.

In all collections, buds at various stages of development were present. In that of Grand Duke plum made on 30th January, for example, several buds were showing the first signs of differentiation (stage 2), whilst the most advanced contained flower primordia in which stamens were arising (stage 6). The majority, however, were in stages 4 and 5, as shown in the Table.

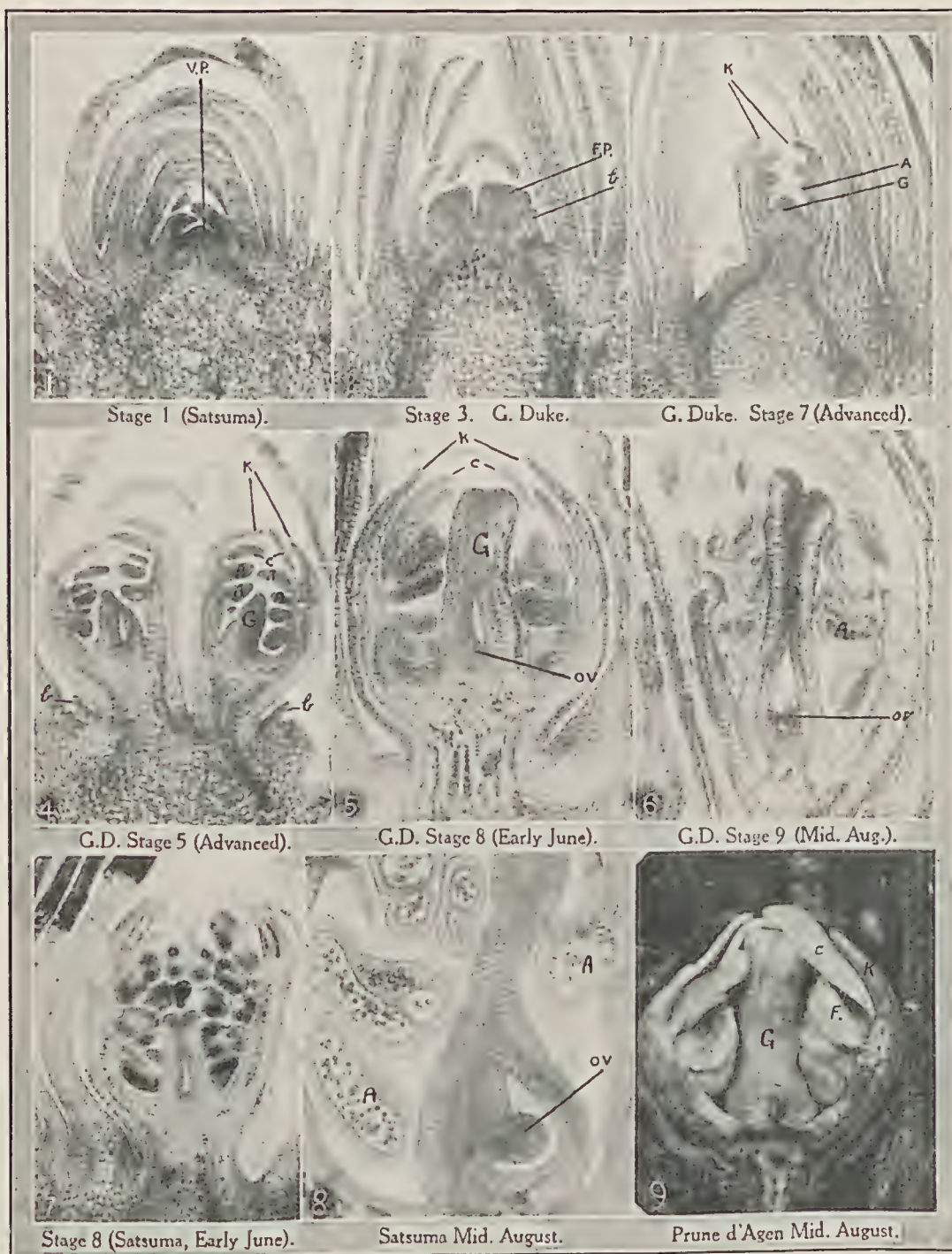


Plate 2.—Blossom bud development in the Grand Duke and Satsuma (Figs. 1, 7, and 8) plum. (Magn. $\times 50$.) For key see Plate 1.

these two sorts differentiate their blossoms, Satsuma being the later. This would seem to indicate that local conditions in the spurs are controlled by the growth conditions in the tree as a whole.

Axillary buds on the current season's shoots were studied in Prune d'Agen and Satsuma. There was a marked difference in growth habit between these two plums—elongation of shoots ceasing more than two months earlier in the former. Nevertheless differentiation of blossom in the axillary buds of current season's growth occurred in both sorts three to four weeks after the shoots had ceased to elongate. In Satsuma, when both spur buds and axillary buds were studied, the former are seen to differentiate three to four weeks ahead of the latter.

If the suggested relation between blossom differentiation and shoot growth cessation can be verified by further observations, the period of blossom differentiation could be readily calculated in the orchard from the date of disappearance of the very pale green colour from the young tip leaves of the shoots—a very clear cut and easily observable feature, which practically coincides with cessation of growth of the shoots.

Summary.

1. The bearing of such work as is here reported upon the general problem of fruitful-

ness in trees has been more fully discussed in previous communications (2) (3).

2. The dates of blossom initiation in several varieties of plums in England, Holland, and America are given in Table I. The necessity for determining these dates in each large fruit-growing area is indicated, and also the desirability of correlating such data with the vegetative growth of the trees.

3. The Grand Duke and Satsuma plums have been studied at Templestowe; while at Shepparton Prune d'Agen has been observed. In all cases periodical measurements of the main growth features have been made; and also microscopical examination of the developing blossom buds. Growth data are summarized in Table II. and Figures 1 and 2. Blossom bud differentiation and development is summarized in Table III. and Plates 1 and 2.

4. Blossom differentiation in Grand Duke and Prune d'Agen occurs towards the end of December. In Satsuma it is much later—middle February. Both spur buds and axillary triple buds on current season's wood were studied in the Satsuma. The axillary buds were found to be nearly a month later than the spur buds in their blossom differentiation.

5. A fairly consistent relationship between the time of blossom initiation and the cessation of growth of shoots can be traced. Initiation appears to follow very closely the termination of shoot growth.

No. IV.—A Year's Observations on Growth and Fruit Bud Formation in the Apricot and Peach

The significance and application of careful studies of vegetative growth and fruit-bud formation in orchard trees has been discussed in previous articles of this series (2), (3), (4), which dealt with the apple, pear, and plum. The present communication contains a further contribution to our knowledge of fruit-bud formation and growth, and deals with the apricot and peach in Victoria.

The results of the observations of other investigations in connexion with these fruits are briefly summarized in Table IV.

Apart from the determination of the time of differentiation, little attention has been devoted to these fruits. Wiggans (15) found

TABLE IV.—INITIATION OF BLOSSOM BUDS OF APRICOT AND PEACH.

Variety.	Initiation of Blossom Buds First Noted.	Locality.	Investigation.
Royal Apricot ..	Aug. 4th, 1915	California	Walker (14)
Royal Apricot ..	Aug. 10th, 1916	California	Walker (14)
Royal Apricot ..	Aug. 11th, 1922	California	Wiggans (15)
Royal Apricot ..	Aug. 10th, 1923	California	Tufts & Morrow (13)
Bokhara Peach ...	Sept. 21st, 1900	Wisconsin	Goff (7)
Luster Peach ..	July 7th, 1909	Virginia	Drinkard (5)
Deming's Peach..	June 14th, 1900	Georgia	Quaintance (11)
Elberta Peach ..	June 30th, 1923	California	Tufts & Morrow (13)

that differentiation in the Royal apricot occurred at approximately the same time in

different climatic zones in California, and was not influenced by the severity of pruning, though it was apparently slightly retarded by irrigation. The rate at which the development of the buds proceeded after differentiation, however, was correlated with the climatic zone and the practice of irrigation; the humid coastal conditions hastening and irrigation delaying development. In this respect also the severity of winter pruning had a slight influence and apparently severe pruning retarded development in the blossom buds.

It is interesting to note also that the time of differentiation in the Royal apricot in California occurred at approximately the same period during the four different seasons in which determinations were made.

The dates of initiation of blossom buds in peaches are seen to be much more variable. It is doubtful, however, if the date given by Goff (6) and (7) need be seriously considered. During the same season Goff noted very late initiation in apples also; and he suggested that there were two periods of initiation. This has never been substantiated; and it would appear that a most unusual type of growth was experienced during the season in which he worked.

This illustrates the necessity for recording not only the progress of blossom formation, but also the parallel vegetative development of the trees in a study of this kind. Were growth data always available they would possibly explain most of the discrepancies between the findings of different workers and permit a much more reliable use of their results in succeeding years, and more particularly, in other countries.

Sources of Material.

Apricot and peach trees growing in two representative Victorian districts have been used for this study. In the Templestowe district, typical of the cooler southern coastal areas near Melbourne, irrigation is restricted to small quantities of water drawn from the municipal water supply mains, supplemented with rain water from small dams. In this area the Moorpark apricot and the Anzac peach have been studied.

Anzac is an early to mid-season freestone variety propagated from a locally-raised seedling, and now extensively planted.

Shepparton is in the Goulburn Valley irrigation area, about 100 miles inland to the north of Melbourne, and enjoys a much warmer

summer climate than Templestowe. Apricots and peaches in the Goulburn Valley are grown principally for canning, and the two main varieties—Moorpark apricot and Pullar's Cling peach—have been observed. Pullar's Cling, like Anzac, has been propagated from a locally-raised seedling. It is a late season clingstone variety.

The blossom buds of the peach are developed in the axils of leaves on the current season's shoots. On strong shoots they usually occur in triple-bud formations, the central bud of which is the leaf bud; and the two side buds are usually fruit buds. Single buds on the weaker growing current season's wood may sometimes also form blossom. In this examination strong triple buds were always selected.

The blossom buds of the apricot are borne, as in the peach, in the axils of leaves on the current season's shoots, more particularly towards the tip of the shoot. One to several buds may occur in each axil; but two or three are the numbers most usually seen. The apricot also forms blossom freely in the terminal and axillary buds of small spur growths. At Shepparton the crop is carried in both positions; but at Templestowe the latter type of fruit bud alone is used, the strong previous season's shoots being rigorously removed in the dormant season's pruning: Axillary buds on current season's wood, however, have been sampled during the course of this work in both districts.

Microscopical Examination of Buds.

The microscopical examination of the buds was made by means of the two methods previously described (1 and 2), viz., microtome sections and dissections under a binocular microscope. The dissection method proved invaluable again in obtaining an accurate conception of the structure of the blossom bud especially during its initial stages of development. It also rendered possible the examination of a large number of buds (approximately 1,000).

The photomicrographs, selected to illustrate the development of the buds, have, however, been made of sectioned material. As the buds of the apricot and peach are somewhat similar in structure and development to those of the plum, the photomicrographs of dissections of plum buds, which accompany article No. III. of this Series (4) may serve to illustrate the views obtained by this method of examination.

BLOSSOM BUD DEVELOPMENT.

(a) Organization of the Flower Bud.

The apricot (*Prunus armeniaca* var.) and the peach (*Prunus persica* var.) possess "simple" blossom buds which are comparable in structure and development to those of the plum and prune (4) (*Prunus domestica* and *Pr. salicina* vars). In the peach there are usually eleven bud scales and two bracts inserted in spiral sequence on the axis and one flower is produced in each bud. The outer scales are short, hairy and slightly trifid, whilst the inner ones are very hairy and tripartite. The latter feature is more pronounced in Pullar's Cling than in Anzac.

In the Moorpark apricot the bud consists of from 24 to 26 bud scales, one bract and a single flower. The outer scales are very short with a broad base, membranous, glabrous and irregular in shape. The inner ones are longer and slightly trifid with a few short hairs towards the apex and on the margins. The 23rd, 24th, 25th and 26th scales are definitely trifid, pinkish in colour and ciliated on the margins. The bract is very small, inconspicuous and triangular in shape, and can be distinguished only whilst the flower is in the early stages of development.

(b) Differentiation and Development of the Blossom Buds.

The potential blossom buds cannot be distinguished from potential leaf buds during the early part of the season. Differentiation occurred in the Anzac peach at Templestowe during the second and third week in January, in Pullar's Cling peach and Moorpark apricot at Shepparton, during the latter half of January, and in the Moorpark apricot at Templestowe about a fortnight later. The appearance of the buds before differentiation occurs is described in Stage 1 below.

Stage I. (Fig. 1, Pl. 3). — Prior to the differentiation of the buds as blossom or leaf buds, the growing point is small and conical, and bud scale initials are split off very rapidly. In the apricot especially, the growing point is most inconspicuous and is surrounded by a rosette of numerous small scales.

Stage II. (Fig. 1, Pl. 4). — The first indication of differentiation is observed when scale formation ceases and the growing point enlarges.

Stage III. (Fig. 2, Pl. 3, Fig. 2, Pl. 4). — In the peach two small bracts arise on the enlarged apex and one, or occasionally two flower primordia are produced as in the plum. In the apricot generally only one bract can be distinguished; in both the apricot and the peach it appears that when two primordia are produced, they arise laterally on the vegetative growing point and each is subtended by a bract. Two primordia are usually observed however only during the very early stages of development and one generally aborts before any parts of the flower are formed.

When a single primordium is formed it arises apparently from the enlarged growing point or apex. The second primordium is completely suppressed and though two bracts (Fig. 2, Pl. 3, "b") are present in the peach, only one is found in the apricot* ("b," Fig. 4, Pl. 4).

Stage IV. — The flower primordium becomes flattened on top preparatory to the formation of the flower parts. Five sepals (K) arise from a ridge on the flattened top of the primordium (Fig. 3, Pl. 2).

Stage V. — The petal primordia (C) arise as five small protuberances alternating with the sepals.

Stage VI. (Fig. 3, Pl. 3). — The stamens (A) arise as small papillae which are arranged in three cyclic rings.

Stage VII. — The carpel (G) arises as a protuberance from the base of the receptacle and rapidly becomes the dome shaped structure as shown in Fig. 4, Pl. 3, and Fig. 4, Pl. 4. This stage is reached by Pullar's peach and the apricots during April and the Anzac peach by the end of March.

Subsequent development consists of the growth of the parts of the flower and is illustrated in the photomicrographs in Figs. 5—9, Pl. 3, and Figs. 6—8, Pl. 4.

In the case of the peach the parts of the flower develop rapidly and the stage reached by the beginning of May is illustrated in Fig. 5, Plate 3. The anthers and filaments of the stamens have been formed and a loculus is

* It is interesting to note that, in the varieties of the genus which have been examined, a gradual reduction in the number of flowers produced in each bud has been apparent. In the Satsuma plum (*Prunus salicina* var.) (4) three or four flowers and as many bracts are normally produced, and these are obviously lateral in origin. In the Grand Duke plum (*Prunus domestica* var.) (4), usually two flowers and two bracts are produced and the axillary nature of the flowers is again apparent. In the Prune d'Agen (*Prunus domestica* var.) (4) two primordia and two bracts are very commonly produced, though usually one primordium aborts. In the peach (*Prunus persica*), as we have seen, usually only one primordium is formed though two bracts are always present, whilst in the apricot (*Prunus armeniaca* var.) usually only one bract and a single flower arise. In both the peach and the apricot the single flower primordium occupies a definitely terminal position from its initiation.

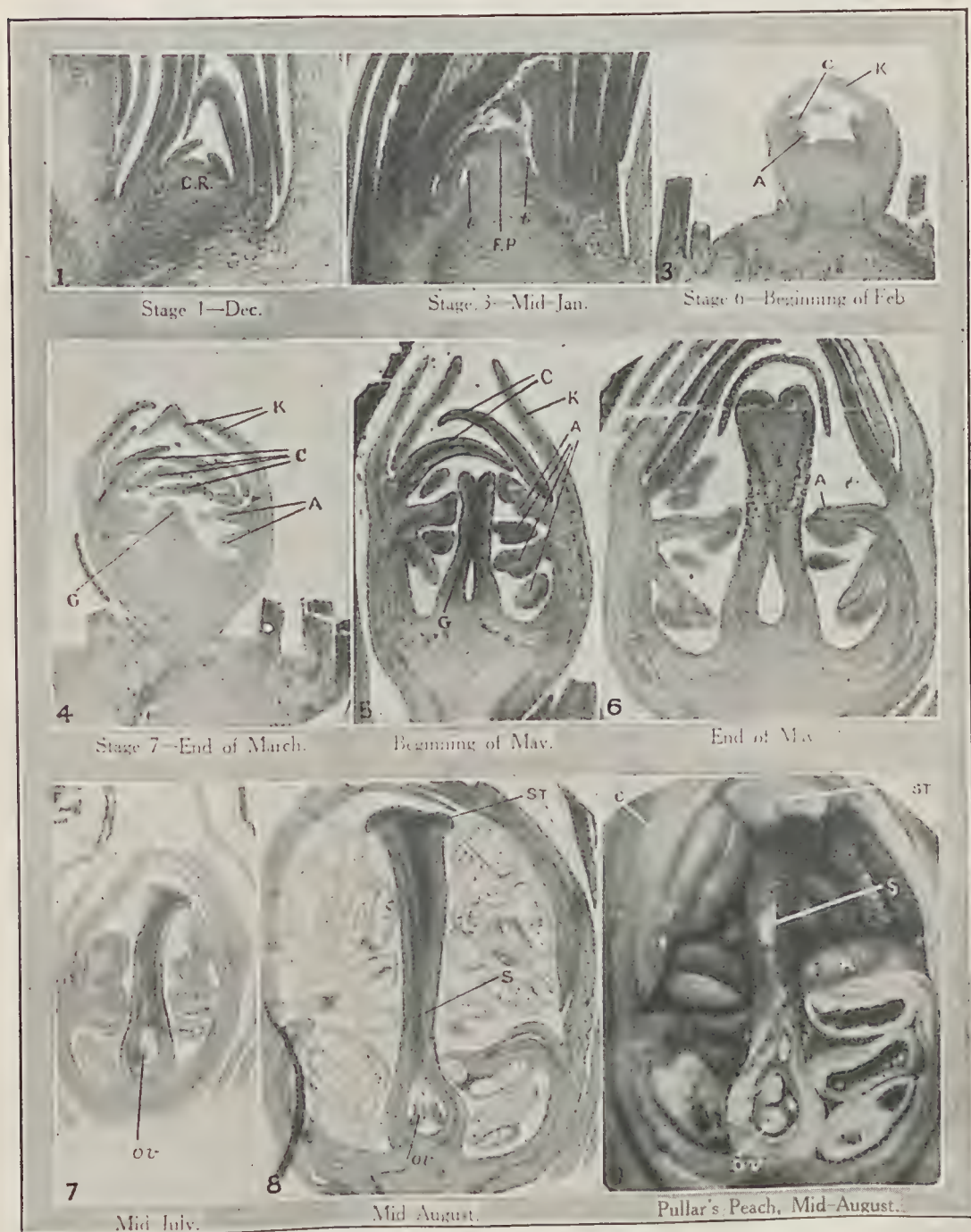


Plate 3.—Blossom bud development in the Anzac Peach, Templestowe, Vic. (Figs 1 to 6, magn. $\times 50$; Figs. 7 to 9, magn. $\times 25$.) For key see Plate 1.

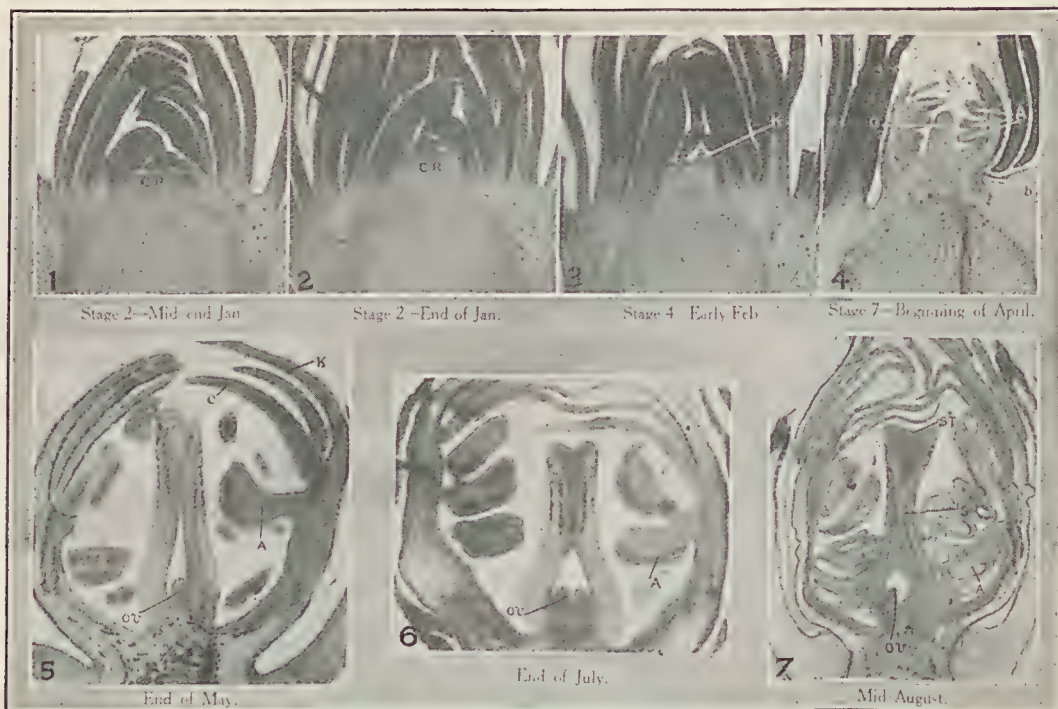


Plate 4.—Blossom bud development in the Moorpark Apricot, Shepparton, Vic. (Magn. $\times 36$; Fig. 7 $\times 18$.)

present in the ovary, though no ovules have arisen. By the end of May the parts of the blossom have increased considerably in size (Fig. 6, Pl. 3) and spore mother cells are differentiated in the anthers. Very little further development occurs during June, but by the middle of July ovules are present in the ovary, and pollen has been formed in the anthers (Fig. 7, Pl. 3). Further development consists of an enlargement of the parts of the now complete flower. Fig. 8, Pl. 3, illustrates the stage reached by the Anzac peach on 14th August, and Fig. 9 represents the typical condition of a Pullar's Cling blossom bud about one week later (21st August, 1931).

Several ovules are usually developed in the ovary as is seen in these photomicrographs (Figs. 8 and 9). Only one, however, actually matures, and though the development of the blossom was not followed further it is apparent that the supernumerary ovules are aborted.

In the apricot the growth of the blossom is even more rapid than in the peach. Figure 4, Pl. 4, illustrates the stage reached by the majority of buds at the end of March. By the third week in May the parts of the flower had increased considerably in size. Spore mother cells were present in the anthers, and one or

more ovules had been formed in the ovary (Fig. 5, Pl. 4). The buds remained in this condition during June and July. Growth commenced again some time during the early part of August, for by the 14th of that month, at Templestowe, and by the 21st, at Shepparton, the typical appearance of the buds was similar to that represented in Fig. 8, Pl. 3. The whole blossom had increased in size, and the spore mother cells had divided to form pollen. As in the peach, two or three ovules are usually formed, and probably the supernumerary ones are aborted. Table V. summarizes the progress of bud development throughout the season.

Growth of Trees.

General observations and careful measurements of a limited nature were made periodically throughout the year on the growth of the trees from which buds for examination were collected. Table V and Figs. 3 and 4 summarize the results obtained.

The season under review, 1930-31, was an abnormally rainy one, and very strong growth of both apricots and peaches in both districts was made. The Moorpark apricot at Templestowe grew very rapidly (Fig. 3, Graph 1) from bud burst until towards the end of

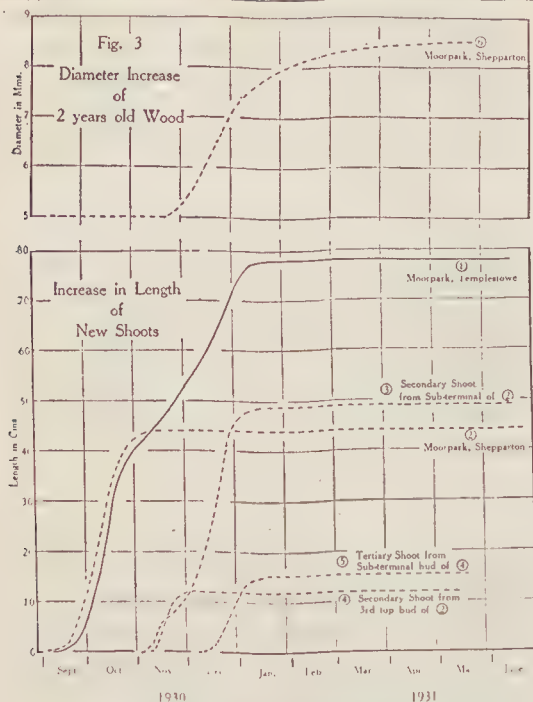


Fig. 3.—Showing Diameter Increase of two-years'-old wood and increase in length of new shoots in the Moorpark Apricot, Shepparton, 1930-31.

October, when a slowing down in shoot growth occurred. During the latter half of November and most of December heavy rains were experienced, growth again quickened and continued strongly until mid-January.

At Shepparton the Moorpark followed much the same course as at Templestowe until early November, when the length growth of the

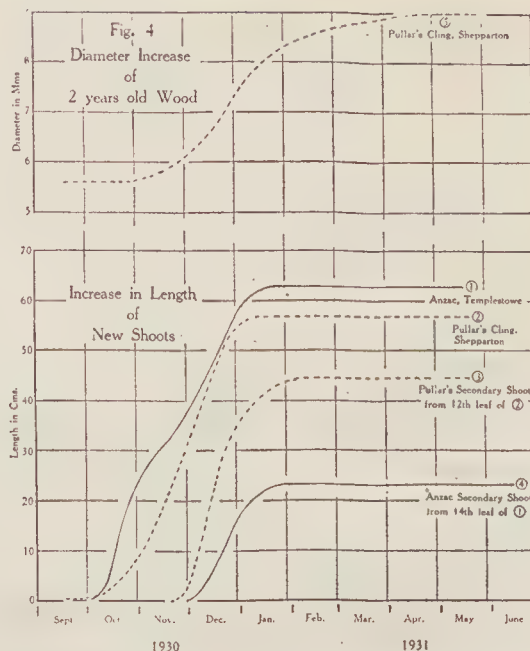


Fig. 4.—Showing Diameter Increase of two-years'-old wood and increase in length of new shoots in the Anzac Peach at Templestowe and Pullar's Cling Peach at Shepparton, 1930-31.

primary shoots ceased. The stimulating effect of rain and irrigation is seen in Fig. 3 (graphs 2, 3, 4, and 5) to have produced new growth at Shepparton, not as an extension of the shoots already produced; but as a growth of new shoots from the axils of leaves on the first or primary growth, and again from the axils of leaves on the secondary growth.

TABLE V.—DETAILS OF GROWTH OF APRICOT AND PEACH TREES AT SHEPPARTON AND TEMPLESTOWE, VICTORIA, SEASON 1930-31.

	Peach.		Apricot.	
	Var. Anzac Templestowe.	Var. Pullar's Cling Shepparton.	Var. Moorpark Templestowe.	Var. Moorpark Shepparton.
Full bloom	September 10th	September 12th	September 3rd	August 29th
Leaf bud burst	September 20th	September 18th	September 10th	September 7th
Commencement of thickening of two year wood	No data ..	November 12th	No data ..	November 25th
Cessation of shoot growth—				
(a) first growth	December 17th	December 14th	January 19th	November 10th
(b) second and later growths axillary from (a)	January 23rd	February 1st ..		January 27th
Fruit matures	January 1st ..	March 2nd ..	January 9th ..	December 30th
Defoliation commences	April 10th ..	April 30th ..	March 20th ..	April 1st
Defoliation complete	May 20th ..	July (late) ..	May 30th ..	May 30th

* The development of the buds from March to August is described in the text.

The apricot is prone to a cyclic type of growth, and it is often found at the conclusion of a growth cycle that the terminal growing point has been abscised. Any renewed growth must, in such a case, be made from an axillary bud.

It would appear that at Templestowe this abscission had not occurred before the stimulus was received; and the primary shoots continued growth without giving rise to secondary and tertiary shoots from the axils of leaves. At Shepparton growth was always a little in advance of Templestowe, and here the stimulus appears to have been preceded by abscission of the terminal growing points.

Fig. 3. (Graphs 3, 4 and 5) shows that a similar phenomenon occurred in the secondary growth. The sub-terminal bud of the primary shoot, after having rapidly grown out as a secondary shoot 7 to 8 cms., and then slowed down, received, late in November, a stimulus from the first irrigation of the season, and its growth was accelerated before it finally ceased early in January (Fig. 3, Graph 3). The axillary bud below this sub-terminal had also by late November developed into a short secondary growth (Fig. 3, Graph 4) which, however, did not continue to elongate after that date; but instead it developed a tertiary growth (Fig. 3, Graph 5) from the bud in the axil of its own sub-terminal leaf.

Apparently axillary growth is limited by continued activity at the terminal growing point of the primary shoot for no axillary shoots were observed on shoots continuing to elongate. On the other hand axillary growth from the sub-terminal bud did not appear to inhibit other axillary growths below it. These were seen to be frequently numerous, and occasionally almost as long as the sub-terminal itself.

Fig. 4 illustrates the growth of the peaches. The curve for Anzac (Fig. 4, Graph 1) resembles the curve for the Moorpark apricot at Templestowe. The same increase in rate of growth in late November and December is noticeable in both and is obviously associated with the abnormal rains. The peach, however, has produced, both at Shepparton and Templestowe (Fig. 4, Graphs 3 and 4), secondary axillary shoots while the primary shoots continue to elongate. In this it differs from the apricot in these studies.

Fig. 4, Graph 5, and Fig. 3, Graph 6, together with Table V., indicate that the diameter increase of the two years' old wood began

in the peach at Shepparton in early November and in the apricot towards the end of November. That is to say it began during the active growth period and continued throughout the season practically until defoliation was about to commence. No data are available for Templestowe.

It should not be forgotten that, as in previous articles (2, 3 and 4), the growth discussions and data are designed to give general information only, as to the progress of vegetative development of the trees in relation to the dates of initiation and development of fruit buds. The observations are not sufficiently numerous to enable an accurate quantitative estimate of tree growth to be made. Figs. 3 and 4 represent what are considered to be fairly typical shoots.

Discussion.

Apricot.

Blossom bud initiation in the axils of leaves on strong shoots of the apricot in both localities commenced at about the time of shoot growth cessation. At Templestowe, it occurred ten days to a fortnight after the shoots had ceased to grow; while at Shepparton growth cessation and initiation practically coincided. As was pointed out previously the primary shoots at Shepparton ceased growth early in November, subsequent growth occurring in the axils of the leaves of the primary shoots. Thus the buds examined, namely axillary buds on the primary shoot, had been formed more than two months before blossom initiation within them occurred. Initiation in these buds coincided with cessation of growth of secondary shoots from similar adjacent buds.

At Templestowe the blossom buds were formed towards the distal end of primary shoots which, it has been shown, continued to elongate until after the middle of January and developed no secondary shoots. The potential blossom buds at Templestowe were probably, therefore, much younger than those at Shepparton and for this reason, possibly, they did not initiate blossom until a fortnight after shoot growth had ceased.

Walker (14) in 1915, in California, found that spur buds of the Royal apricot initiated blossom 20 to 24 days ahead of axillary buds on vegetative shoots; but that in the following year the difference was only eight days. It is probable that differences in the type of growth made in these two seasons, comparable to the differences between the growth made at Shepparton and Templestowe in 1930-31 season were responsible for this variation.

Although blossom initiation at Templestowe was two to three weeks later than at Shepparton the subsequent development of the blossom buds at Templestowe appears to have been more rapid; and the carpel stage is seen (Table VI.) to have been reached earlier than at Shepparton.

Wiggans (15) has recorded a similar condition in California. Under coastal valley conditions the blossom buds of Royal apricot are more advanced before winter-sets in than are similar buds grown in the hotter interior valley irrigated areas. Shepparton and Templestowe are relatively comparable in climate with the "interior valley" and "coastal valley" regions respectively.

Peach.

Blossom initiation in both varieties of peaches studied occurred in the latter half of January just prior to the completion of shoot growth. Thus in the pear (3), plum and prune (4), apricot and peach there is a close correlation between the cessation of shoot growth and blossom initiation.

There appears to be no correlation between the dates of fruit maturity and initiation in the peach. This was the case also in the apple (2). These results therefore are not in accord with those of Johansson (9) in Sweden, who says, "There is no doubt that the time of the beginning of blossom bud development in all the kinds of fruit examined varies with the time of ripening of the different varieties." It is possible, however, that the more rapid

subsequent development of the Anzac buds is connected with the early removal of the Anzac crop (beginning of January), as contrasted with the Pullar's Cling, which was developing its fruit until March.

On the other hand, climatic factors which, it has been suggested, are responsible for the more rapid development of the Moorpark apricot at Templestone than at Shepparton may be here, too, more important than the dates of picking of the fruit.

Summary.

1. The dates of initiation of blossom buds of the apricot and peach as determined by American workers are given in Table IV., and the desirability of having parallel data on the vegetative growth of the trees examined is briefly indicated.

2. Observations made during season 1930-31 in Victoria are here reported. The Moorpark apricot and the Anzac peach have been studied at Templestowe, a cooler non-irrigated coastal district near Melbourne; while at Shepparton, in the hotter inland irrigation areas of the Goulburn Valley, the Moorpark apricot and Pullar's Cling peach have been observed.

3. In Table VI. and Plates 3 and 4 are summarized the data for fruit bud initiation and subsequent development in these varieties; and a detailed description is given in the text under the heading "Blossom Bud Development." Differentiation of fruit buds occurred in the Anzac peach during the second and third week in January; in Pullar's Cling peach and

TABLE VI.—SHOWING DEVELOPMENT OF BLOSSOM BUD THROUGHOUT SEASON.*

The period during which buds are in the stages shown is indicated by reference to the weeks in the month. The actual dates refer to the time at which the most advanced buds reached the stage indicated.

Variety.	Stage 2. Differentiation.	Stage 3. Flower Primordia.	Stage 4. Sepals.	Stage 5. Petals.	Stage 6. Stamens.	Stage 7. Carpels.
Anzac Peach ..	2nd and 3rd week in January	3rd and 4th week in January	3rd and 4th week in January	4th week in Janu- ary	4th week in Jan., 1st week in Feb.	Mid-March
Templestowe ..	9th January, 1931	16th January, 1931	...	23rd January, 1931	30th January, 1931	13th March, 1931
Pullar's Cling ..	3rd and 4th weeks in January	End of January and 1st week in February	1st and 2nd week in February	Mid-February ..	3rd week in Feb- ruary	End of March
Shepparton ..	12th January, 1931	26th January, 1931	2nd February, 1931	9th February, 1931	16th February, 1931	9th March, 1931
Moorpark Apricot	1st, 2nd, and 3rd week in February	2nd, 3rd and 4th week in February	End of February, and 1st week in March	2nd week in March	About Mid-March	During March
Templestowe ..	30th January, 1931	6th February, 1931	20th February, 1931	27th February, 1931	27th February, 1931	27th Feb- ruary, 1931
Moorpark Apricot	3rd and 4th week in January	End of January and 1st week in February	2nd week in Feb- ruary	3rd and 4th week in February	4th week in Feb- ruary, 1st week March	2nd week in March
Shepparton ..	12th January, 1931	26th January, 1931	2nd February, 1931	9th February, 1931	23rd February, 1931	9th March, 1931

Moorpark apricot at Shepparton during the latter half of January and early February; and in the Moorpark apricot at Templestowe during the first three weeks of February.

4. Measurements of tree growth were made periodically throughout the year, and the results are summarized in Table V. and Figures 3 and 4. They are discussed in the section "Growth of Trees."

5. Blossom bud initiation in the axils of leaves on the current season's shoots in the apricot, in both localities, is seen to commence about the time shoot growth ceases. Although blossom initiation at Templestowe was two to three weeks later than in the hotter inland Shepparton area, subsequent development of the buds was more rapid in the former locality. This is in agreement with the findings of Wiggins, who compared apricots growing under coastal valley conditions in California with those from the hotter interior valley irrigation areas.

6. Blossom bud initiation in the peach in both centres occurred just prior to growth cessation in the current season's shoots. In the peach, as in the apricot, subsequent bud development at Templestowe was somewhat more rapid than at Shepparton.

7. There appears to be no correlation in these varieties between the times of fruit maturity and fruit bud initiation, such as has been found by Johansson in Sweden (9). The Anzac crop ripens approximately two months earlier than that of Pullar's Oling, and yet they practically coincide in their dates of initiation. The more rapid subsequent bud development in Anzac may be due in some measure to the earlier removal of the crop, although, as suggested above, climatic factors are probably more important, since the same phenomenon is noticeable in apricots of the one variety.

8. For Victorian fruits so far examined (2), (3), (4), the growth feature most consistently related to blossom initiation is shoot growth. Initiation usually occurs at or about the time when shoot growth ceases.

Acknowledgment.

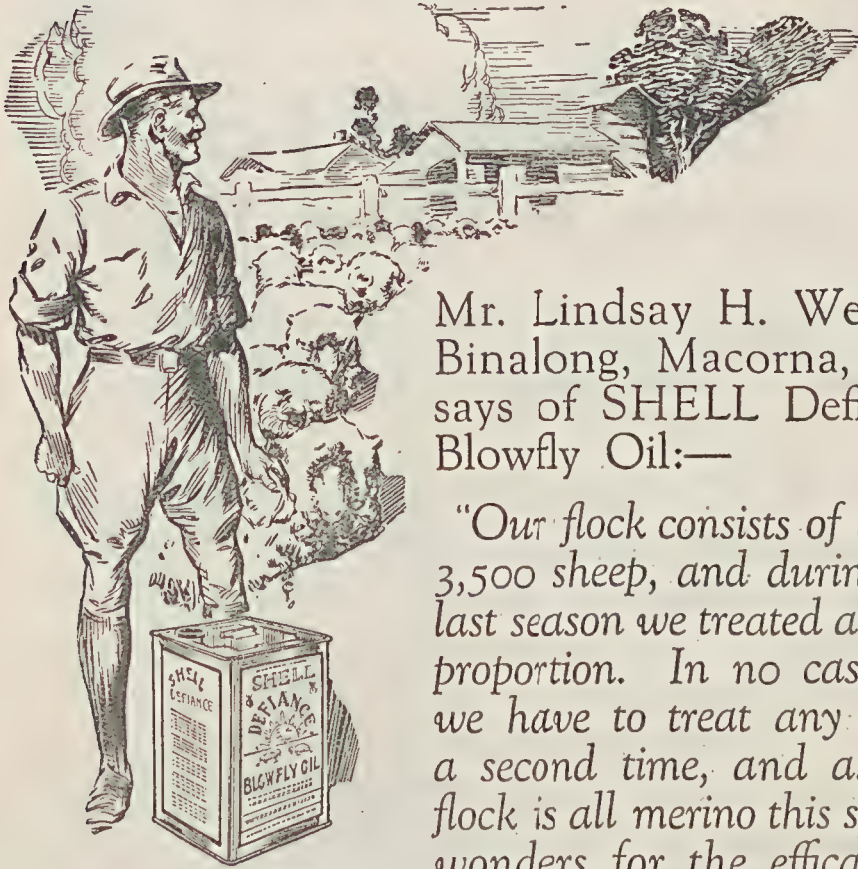
The thanks of the authors are due to Messrs. W. Lees and S. D. Smith, of High-street, Templestowe, who placed orchards at their disposal; to Mr. W. Gilchrist, manager of the High School Farm, Shepparton, who made available trees, and often rendered assistance in the observations; and to Mr. A. A.

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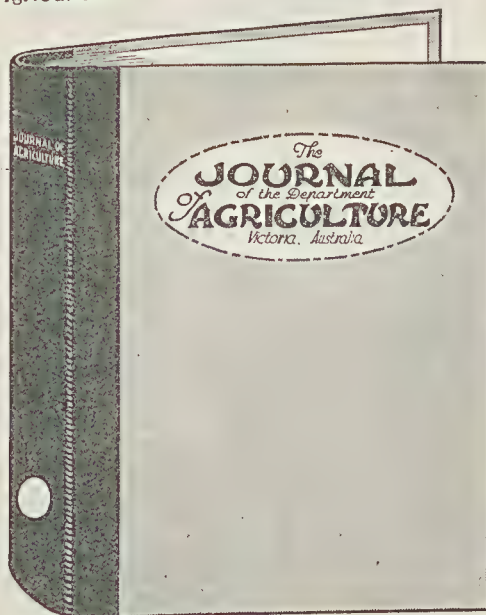
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